This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

1,069,993

5.

1837
ARTES
VERITAS
SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
TUEBOR
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE

43

QE
262
.C8
A2
v. 8, pt. 1

1225-9

OBSERVATIONS

ON

METALLIFEROUS DEPOSITS,

AND ON

SUBTERRANEAN TEMPERATURE;

FORMING THE EIGHTH VOLUME OF THE TRANSACTIONS OF THE ROYAL GEOLOGICAL SOCIETY OF CORNWALL.

PART THE SECOND.

BY

WILLIAM JORY HENWOOD, F.R.S.; F.G.S.;

MEMBER OF THE GEOLOGICAL SOCIETY OF FRANCE;
PRESIDENT OF THE ROYAL INSTITUTION OF CORNWALL;
HONORARY MEMBER OF THE YORKSHIRE PHILOSOPHICAL SOCIETY;
CORRESPONDING MEMBER OF THE IMPERIAL AGRICULTURAL AND NATURAL HISTORY SOCIETY—LYONS, AND OF THE LYCEUM OF NATURAL HISTORY—NEW YORK;
SOMETIME HER MAJESTY'S ASSAY-MASTER OF TIN IN THE DUCHY OF CORNWALL.

PENZANCE:
PRINTED AND PUBLISHED BY
WILLIAM CORNISH,
GREEN MARKET.

1871.

CONTENTS.

Observations on Subterranean Temperature. By WILLIAM JORY HENWOOD, F.R.S.; F.G.S.; Member of the Geological Society of France; President of the Royal Institution of Cornwall; Honorary Member of the Yorkshire Philosophical Society; Corresponding Member of the Imperial Agricultural and Natural History Society —Lyons, and of the Lyceum of Natural History—New York; sometime Her Majesty's Assay-Master of Tin in the Duchy of Cornwall; Member of the Society.

CHILI.

CHAÑARCILLO.

Colorada. Temperatures at the surface and in the rocks at various depths. 724—725.

BRAZIL.

MINAS GERAES.

Morro Velho. Temperatures,—of air at the surface,—and of water issuing from the rock and the metalliferous deposits at various depths. 725—727.

Gongo Soco. Temperatures,—of air and of wells at the surface,—and of streams issuing from the rock and the metalliferous deposit at various depths. 727—729.

Agoa Quente. Temperatures,—of air and water at the surface,—of streams issuing from the rock and the metalliferous deposit, —and of water accumulated in the mine. 729—731.

Fraga. Temperature of water issuing from the metalliferous de-deposit. 732.

NORTH AMERICA.

VIRGINIA.

Garnett and Moseley. Temperature of water pumped to the surface. 733.

MICHIGAN.

Toltec and Douglass Houghton (Henwood). Formation of ice in the works during winter. 733—734.

THE CHANNEL ISLANDS.

SARK.

Windmill Hill. Temperature of water in a well at the surface, 735.
Port ès Sées. „ streams issuing from the rock and *lode* at different depths. 735.
Le Pot. „ streams issuing from the rock and *lode* at different depths. 736.
Sark's-Hope. „ streams issuing from the rock and *lode* at different depths. 736.

HERM.

Mine. Temperature,—of water in a well at the surface,—and of streams issuing from the rock and the *lode* at various depths. 737.

KERRY.

Ardtully. Temperature of water issuing from the rock and *lode*, at different depths. 744.

ENGLAND.

CORNWALL.

CARADON. ..... Temperature of water in a well at the surface. 745.

Gonamena. „ water flowing from the rock and *lode.* 746.

South Caradon. „ water flowing from the rock the *lodes*, and the *cross-veins*, at different depths. 746.

Phœnix. „ water flowing from the rock and *lode.* 746.

Mark Valley. „ water flowing from the *lode.* 746.

MENHENIOT. ..... Temperature of water in neighbouring wells at the surface. 748.

South Wh. Trelawny. „ water issuing from the *branches* at different depths. 748.

Wheal Mary Ann. „ water issuing from the *lode* at different depths. 748.

Wheal Trelawny. „ water issuing from the *lode* at different depths. 748.

LANREATH & SAINT PINNOCK. ..... Temperature of water in neighbouring wells at the surface. 749.

Herod's-foot. „ water issuing from the *lode* at various depths. 749.

HROP SHIRE.

Eardiston. Temperature of the water issuing from the rock and the metalliferous deposit, at various depths. 751.

On the mean depths, — temperatures, — and rates at which the temperatures increase with the depths, — of mines in each region. 751—752.

On the mean depths, — temperatures, — and rates at which the temperatures increase with the depths, — of mines in different rocks. 752—756.

On the mean depths, — temperatures, — and rates at which the temperatures increase with the depths,—of mines yielding different metals and ores. 756—758.

On the mean depths, — temperatures, — and rates at which the temperatures increase with the depths,—of mines affording similar metals and ores in different rocks. 757—758.

On the mean depths, — temperatures, — and rates at which the temperatures increase with the depths, — of mines wrought at different altitudes. 758—759.

Observations at different (mean) depths, in elevated tropical regions, and at smaller elevations in temperate climates. 760—761.

On the influence of deepening shafts and opening *(levels)* galleries on the normal temperatures of mines. 763—765.

On occasional interruptions in the progressive increase of temperature with depth. 765—766.

On the change of temperature which takes place—at the same, and at different, times,—on the surface, and at depths of three, six, and nine feet in the *Canga*, at *Agoa Quente*—Brazil. 767—780.

Explanations of the Plates and Woodcuts. 781—782.

Index. 783—916.

CHILI.

CHAÑARCILLO.

III. Relations between the rocks, the metalliferous deposits, and the *cross-veins*, at *Colorada* and *Desempeño*.

IV. Description of ore and (approximate) quantities of silver obtained from rich *(bunches)* parts of the *Colorada lode*.

V. Forces employed and amounts paid for Salaries, Wages, Food, and Materials (1856) at *Colorada*.

BRAZIL.

MINAS GERAES.

VI. Relations between the rocks and the metalliferous deposits at *Morro Velho*.

VI.$_a$ Proportions of gold contained in, and extracted from, the vein-stone; force employed to extract it; and cost of its extraction (1855—1861), at *Morro Velho*.

VII. Synopsis of Mining and Financial operations (1835—1861) at *Morro Velho*.

VIII. Relations between the rocks and the metalliferous deposits at *Gongo Soco*.

IX. Synopsis of Mining and Financial operations (1826—1856) at *Gongo Soco*.

X. Synopsis of observations on the Gold-deposits of the Province.

NORTH AMERICA.

MICHIGAN.

XI. Relation between the rocks and the metalliferous deposits of the *North American* mine.

XII. Relation between the rocks and the metalliferous deposits of the *Cliff* mine.

XIII. Relation between the rocks and the metalliferons deposits of the *South Cliff* mine.

XIV. Synopsis of the produce, working-costs, and profits of rich mines in various countries.

XV. Relations between the rocks and metalliferous deposit of the *Douglas Houghton (Henwood)* mines.

FRANCE.

DAUPHINY.

XVI. Relations between the rocks the metalliferous deposits, and the *cross-vein* at *Chalanches*.

THE CHANNEL ISLANDS

SARK.

XVII. Relations between the rocks and the metalliferous deposit of *Sark's-Hope.*

IRELAND.

WICKLOW.

XVIII. Relations between the rocks and the metalliferous deposit of *Connorree.*

XVIII.[a] Quantities of copper-ore calcined,—iron used,—precipitate obtained, —and copper extracted at the *Mona* mine—*Anglesea.*

WATERFORD.

XIX. Relations between the rocks, the *lodes*, and the *cross-veins* of *Knockmahon.*

CORK.

XX. Relations between the rocks, the *lodes*, and the *cross-veins* at *Bearhaven.*

KERRY.

XXI. Relations between the rocks, the metalliferous deposits, and the *cross-vein* at *Ardtully.*

GREAT BRITAIN.

XXVIII. Relations between the rocks, the *lode*, and the *cross-vein* at *Wheal Mary Ann.*
XXIX. Relations between the rocks, the *lode*, and the *cross-vein* at *Herod's-foot.*

XXX. Temperature (surface) of *Gongo Soco*—Brazil.
XXXI. „ „ of *Agoa Quente*— „ .
XXXII. Subterranean temperature in different Countries.
XXXIII. „ „ in different rocks.
XXXIV. „ „ in mines yielding different metals and ores.
XXXV. „ „ in mines affording similar metals and ores in different rocks.
XXXVI. „ „ in mines of different altitudes
XXXVII. Temperatures at the surface, and at depths of three, six, and nine feet in the *Canga* at *Agoa Quente*—Brazil.

CORRECTIONS.

Page.	Line.			
729	19	*for* 18° 50′	*read* 19° 50′	
,,	30	,, 60° 3	,, 66°·3	
770	18	,, *Anserma*	,, *Ansermo*	
805	40	,, proportion	,, preparation	
828	38	,, 163	,, 168	

TABLES.

VII.	33	column 11	*for* 331	*read* 431
,,	36	,, 25	,, 180·87	,, 172·40
,,	41	,, 11	,, 364·	,, 367·
,,	,,	,, 25	,, 220·09	,, 219·75
VIII.	5	,, 15	,, Fig. 24	,, *Fig.* 23.
,,	88	,, ,, ...	,, *w*	,, *t t*
,,	89	,, 14	,, ,, January 21st ..	,, 1830 January 21st
,,	134	,, 21	omit *Fig.* 21	
IX.	13	,, 5	*for* 392	,, 402
X.	9	,, 17	,, Tellurium	,, Tellurium and Silver
,,	48	,, 15	,, 0·6069440	,, 0·0069440
,,	102	Note *b*	,, affords no trace of silver	,, is alloyed with both Silver and Tellurium
XIV. (Synopsis)	6	column 55	,, 0·7640	,, 0·2640

Observations on Subterranean Temperature.

By WILLIAM JORY HENWOOD, F.R.S.; F.G.S.;

MEMBER OF THE GEOLOGICAL SOCIETY OF FRANCE;
PRESIDENT OF THE ROYAL INSTITUTION OF CORNWALL;
SOMETIME HER MAJESTY'S ASSAY-MASTER OF TIN IN THE DUCHY OF CORNWALL;

MEMBER OF THE SOCIETY.

The first series of results* recorded in the following columns, was obtained in an absolutely dry †—though a deep—mine, by placing the thermometers in holes which had sometime before been purposely bored in the several limestones; * all others were determined in streams of water immediately as they issued ‡ from the various rocks and veins.

---

* *Postea*, p. 725.

† "It is in the solid rock that the best observations, and those most suited to the purpose of philosophical reasoning, are to be obtained."

PHILLIPS, *Reports of the British Association*, v. (1836), p. 292.

‡ "I am disposed to attach most importance to observations on springs of water, not coming from the roofs of galleries, or evidently proceeding from higher parts of the mines."—FOX, *Cornwall Geol. Trans.*, III. p. 320.

"After most careful consideration of the subject, and consultation with others who have also been engaged in this enquiry, it has been thought best to confine the observations, as much as possible to the temperature of the streams of water immediately issuing from the unbroken portions of the rocks and veins. The reasons for this preference are;—that the temperature of the *air* in mines is affected, not only by the presence of the workmen, the combustion of candles, and the explosion of gunpowder, but also by the warm or cold air which is brought to the same spot by the varying directions of the currents underground, which are more or less influenced by the changes of wind at the surface; that the *rocks*, forming the sides of the shafts and levels, must, to a certain extent, partake of the temperature of the air circulating through them, and, of course, be affected by its changes;—and that the *water* flowing through, or standing in pools in the levels, is exposed to the same modifying causes, and probably also, warmed by the workmen who frequently stand in it."

HENWOOD, *Ibid*, v. pp. 387—8.

CHILI.

PROVINCE OF ATACAMA.—DEPARTMENT OF COPIAPÓ

DISTRICT OF CHAÑARCILLO. Long. 70° 30′ W., Lat. 27° 15′ S.

Mine of *Colorada*.* Elevation of the surface about 3,650 feet above the Pacific; † 1,750 feet above the plain. ‡

The first,——third,——and fifth strata are of limestone; §
„ second,——and fourth—— „ „ hornblendic rocks.§

The *lodes* yield silver and many of its ores in great abundance; beside iron-pyrites and blende in smaller proportions.||

The extremes of temperature during the year have been considered 52°—68°; ¶
„ mean „ „ has been estimated at about .... 64°.**
The range „ from the 9th to the 15th of June, 1857,..... was 39°·5-66°·5; ††
„ mean „ „ „ about .... 48°·5.††

* *Ante*, p. 90; *Table III.; Pl. I., II.*

† Domeyko, *Annales des Mines*, 4me Série, IX. p. 433. Henwood, *Reports of the Royal Institution of Cornwall*, XXXIX. p. 15; *Edin. New Phil. Journal*, VII. N.S. p. 147.

‡ Henwood, *Reports of the Royal Institution of Cornwall*, XXXIX. p. 15; *Edin. New Phil. Journal*, VII. N.S. p. 147.

The stations at which observations were made, and the temperatures observed underground, were the following:—

Locality.	Depths. fms.	Temperature of rock, in hole 2 feet deep.	Temperature of air circulating through the mine at the same spot.
		°	°
1st Limestone; between *Waring's lode* on the E. and the *Colorada lode* on the W.	46·	64·8	66·
2nd Limestone; " "	127·	67·5	66·75
" " ; at the bottom of the shaft	150·	67·*	66·
3rd Limestone; E. side *(wall)* of the *Colorada lode* .... an unfrequented part of the mine	227·	72·	76·
" " ; " : a frequented part of the mine	"	74·5	76·5

BRAZIL.

PROVINCE OF MINAS GERAËS,—DISTRICT OF RIO DAS VELHAS,—
PARISH OF CONGONHAS DE SABARA'; Long. 43° 50′ W., Lat. 19° 58′ 20″ S.

Mine of *Morro Velho.** Elevation of the surface about 3,250 feet above the sea.

Wrought in clay-slate.

"If, in the absence of observations at midnight, and at 3 a.m., we assume the mean temperatures at those hours to have been 45°, which at this season cannot be wide of the truth; we have an average of about 48°·5 during the twenty-four hours.

"On the 11th of June the thermometer stood at 53°·8 in the shade at noon.
" " 66°·8 " sunshine " .
"On that day and on the 15th of June much rain fell."

HENWOOD, *Reports of the Royal Institution of Cornwall*, XXXIX. p. 15; *Edin. New Phil. Journal*, VII. N.S. p. 148.

* "This observation, made at the bottom of the shaft, where the draught was very great, ought, perhaps, to be excluded from the general average."—*Ibid.*

† Von Eschwege, *Pluto Brasiliensis*, t XVI. Caldcleugh, *Travels in Brazil*,

The metalliferous deposit affords enormous quantities of auriferous iron-pyrites, beside much smaller proportions of arsenical-pyrites and copper-pyrites; * in vein-stones of quartz and quartzose slate.†

From July, 1868, to June, 1869, the temperature at the surface ranged from 40° to 86°, and averaged 66°·84.‡

The temperatures in the same, and in different, parts of the mine § at various times, are shown in the following columns:—

Localities.	Depth. Fathoms.	Localities.‖					
		Bahù.‖			*Cachoeira.*‖		
		Periods.					
		1849,* December.	1863,¶ July.	1864,¶ January.	1849,* December.	1863,¶ July.	1864,¶ January.
		Temperatures.					
Water issuing	19	°	64°	69°·75	°	65°·19	60°·25

Localities.	Depths. Fathoms.	Localities. Bahù. Periods. 1843. December.	1863. July.	1864. January.	Cachoeira. 1843. December.	1863. July.	1864. January.
		Temperatures.					
Water issuing from the rock upper side (*hanging-wall*) S. of metalliferous deposit	28·5	° ..	° 64·5	° 66·	°	°	°
" metalliferous deposit .	45·	68·*	..	..	69·*		
" rock lower side (*foot-wall*) N. of metalliferous deposit	58·6	..	..	67·			
" " ..	77·	..	..	..	..	..	69·16
" rock upper side (*hanging-wall*) S. of metalliferous deposit	145·	..	..	..	..	..	72·*
" " ..	150·	..	..	..	..	..	70·8
" metalliferous deposit .	155·	..	..	..	..	72·*	72·*
Water collected at the bottom of the Engine-shaft	160·	..	65·	69·5	..	69·05	71·5

PARISH OF CAËTHE'; Long. 43° 30′ W., Lat. 19° 58′ 30″ S.

Mine of *Gongo Soco*.† Elevation of the surface about 3,360 feet above the sea.

J. N. Gordon, Esq., Resident Superintendent of the mine, and to the kindness of John Hockin, Esq., Chairman of the Saint John d'el Rey Mining Company.

* "At the celebrated gold-mine of Morro Velho, in Brazil, situate at a height of 3250 feet above the sea, and opened in clay-slate; the water issuing from the rock at 45 fathoms depth, observed in 1843, had a temperature of 69°; that at the bottom of the mine in 1863 and 1864, at 145 and 155 fathoms deep 72°. These temperatures were quite independent of the warm rains a little before and after Christmas, which make themselves felt all the way down the engine-shafts."—SMYTH (Presidential Address to the Geological Society of London in 1868), *Quarterly Journal of the Geological Society*, XXIV, p. lxxxvi., Note.

† Von Eschwege, *Pluto Brasiliensis*, pp. 311—44. Gardner, *Travels in Brazil*, p. 491. Claussen, *Bulletins, de l'Académie Royale de Bruxelles*, VIII. 1re Partie, p. 327. Whitney, *Metallic Wealth of the United States*, p. 111. Phillips (J. A.), *Mining and Metallurgy of Gold and Silver*, p. 84. *Ante*, pp. 248—96, *Pl. IV.*

Wrought, for the most part, in *(Jacotinga*)* iron-glance mixed with black, brown, and yellowish earthy iron-ore, as well as with friable black manganese and both buff-coloured and pearl-white talc; in some places, however, the iron-glance is replaced by quartz.

From (9,459) observations, made at intervals of three hours, it was ascertained, that during 1845, 1846, and 1847 the temperature, at the surface, ranged from 40°·8 to 91°·7, and averaged about 66°·5.†

Streams issuing from the ground have, at different times, been found of the undermentioned temperatures.

Localities.	Depths. fms.	Temperatures. 1843. October.	1845. July.
The water issuing from a low hill S. of the valley,—passes through an ancient, long-abandoned, drift,—some 20 fathoms above the horizon of the *adit* (48 fathom) *level*‡ in the mine, and supplies a well (which is protected from both direct and reflected sunshine) ..... varied at different times ..	..	..	67·3–68·
Water issuing from the pumps at the (48-fm.) *adit level*‡	34·‡	67·	

Localities.	Depths. fms.	Temperatures. 1843. October.	1845. July.
		°	°
Water, a small stream from iron-glance and quartz (*Itabirite*) overlying the auriferous (*Jacotinga*) formation	41·	67·5	67·
„ , „ out of „ ..	48·	67·7—68	
„ , a large stream „ „ ..	„	..	67·
„ , a moderate stream out of auriferous (*Jacotinga*) formation	„	67·7	
„ , „ „	62·	..	67·8
„ , a large stream from between iron-glance and quartz (*Itabirite*), S., and auriferous (*Jacotinga*) formation	„	..	66·8
„ , a moderate stream from iron-glance and quarts (*Itabirite*), N.	„	..	67·3

District of Villa Rica.—

Parish of Cattas Altas. Long. 43° 10′ W., Lat. 18° 50′ S.

Mine of *Agoa Quente.** Elevation of the surface about 3,400 feet above the sea.

Wrought in *Jacotinga*†, composed of quartz in unequal—but sometimes in considerable—proportions, minute crystals of oxydulated and titaniferous iron, scales of micaceous iron-ore, flakes of talc, and small nests of felspar-clay, imbedded in earthy brown iron-ore tinged, at intervals, with earthy black manganese.

During 1848—9 the temperature at the surface ranged from 42°· to 84°·8 (*Table XXXI.*) and averaged about 60°·3.‡

* Von Eschwege, *Pluto Brasiliensis*, p. 299. De Monlevade, *Annales des Mines*, iv. p. 136. Caldcleugh, *Travels in South America*, ii. p. 283.

† Von Eschwege, *Pluto Brasiliensis*, t iv. p. 299. *Ante*, pp. 224—36.

‡ Notwithstanding the monthly means at *Agoa Quente*, between October, 1848,

The undermentioned observations were made at times when very different quantities of rain-water *—absorbed at the surface—found their way into the mine; and when the works were opened at different depths.

Localities.	Depth. fms.	1844. May.	1847. Nov.	1849. Jan.	1849. Apr.	1849. June.
Water in a brook at the surface	..	..	68°	76°	°	°
" out of the *back* of the *(level)* drift at the *end*.	4·5	..	..	73.		
" " " 2 feet from " .	"	..	..	76·		
" " " 3 " " .	"	..	..	74·		
" out of ancient—& long-abandoned—works.	6·	..	70·2			
" , small stream out of *(Itabirite)* rock S. side *(wall)* of auriferous *(Jacotinga)* formation	7·	92·				
" out of ancient-& long-abandoned-works (*a*)	8·	72·				
" , large streams jetting out of auriferous *(Jacotinga)* formation, and *(Itabirite)* rock on both *(walls)* sides of it.....	10·	91·5				

Localities.	Depth. fms.	1844. May.	1847. Nov.	1849. Jan.	1849. Apr.	1849. June.
		°	°	°	°	°
Water, large stream out of auriferous *(Jacotinga)* formation, both E. and W.	26·	..	..	..	90·5	
" , small stream out of auriferous *(Jacotinga)* formation	28·	..	..	..	..	77.8
" , " " within one foot of that last mentioned.	"	..	..	..	..	78·3
" , " out of *(Itabirite)* rock S. side *(wall)* of auriferous *(Jacotinga)* formation	"	..	..	..	..	89·3
" , large stream out of auriferous *(Jacotinga)* formation	"	..	..	..	..	88·
" , " " , within nine feet of that last mentioned....	* "	..	..	..	..	92·
" , " bubbling up out of auriferous *(Jacotinga)* formation....	29·	..	..	..	92·5	
" which filled the mine to within 4·5 fms. of the surface, during a stoppage of the pumps; at one spot	15·	..	82·3*			
" " " at a second spot	"	..	83·3*			
" drawn by pumps to the surface at one shaft (*b*) from	9·	..	81·9			
" " " a second " (*c*) "	"	..	84·			
" " " one shaft (*b*) "	10·	84·				
" " " a second " (*c*) "	"	87·				
" drawn by pumps to the *adit* (14 fathoms deep) at one shaft (*c*) "	18·	..	..	91·		
" " " another " (*b*) "	24·	..	..	83·5		
" " ..... "	29·	..	..	..	91·5	

* Fish throve in this water. *Ante*, p. 355.

The power of fishes to bear extremes of temperature is well known.

YARRELL, *History of British Fishes*, I. pp. 316—19. COUCH, *Fishes of the British Islands*, IV. p. 33.

PARISH OF INFICIONADA; adjoining CATTAS ALTAS.

Mine of *Fraga** or *Ouro Fino.* Elevation of the surface about 3,300 feet above the sea.

Wrought in that part of the talcose-slate series which overlies the (*Jacotinga*) manganesic iron-glance formation.

As *Fraga* is so near *Agoa Quente* and *Gongo Soco*, it, probably, differs little in climate, from them; but, inasmuch as it is less enclosed than they are by mountains and woods, its mean temperature may, perhaps, be somewhat cooler than theirs; on this, however, reliable observations have never been recorded.

The undermentioned temperatures have been observed:—

A large stream as it issues from the auriferous talc-slate into a (adit-*level*) drift opened from the vale	69°.
„ drawn by pumps to the surface from a depth of 21 fms.	70°·5

THE UNITED STATES.

[redacted]

The line of 55° mean annual temperature passes within a short distance of this district, if not directly through it.*

A small stream pumped to the surface from a depth of 15·5 fathoms maintained, during September, 1852, a temperature of 56°.8†

STATE OF MICHIGAN,‡—COUNTY OF ONTONAGON (Long. 89° 30′ W., Lat. 46° 50′ N.).

The rains which immediately precede the first snows freeze almost as soon as they soak into the ground whilst the floods of autumn, which had been already absorbed, are—under influence of cold air, descending from the surface and circulating through the mines,

---

* Keith Johnston, *Atlas of Physical Phenomena, Pl. XVIII.*

† On the 4th of September, 1852, the temperature at the surface about 6 p.m. was 76°.2.

‡ The following temperatures were observed in the Keweenaw district from (two hundred to four hundred feet above Lake Superior) eight hundred to a thousand feet above the sea; in mines wrought, in the trap formation, on *lodes* composed of calcareous-spar, prehnite, quartz, epidote, chlorite, and trappean matter. In most parts of the district some or others of these ingredients are more or less mixed with native copper, and this is frequently encrusted with virgin-silver (BAYFIELD, *Quarterly Jour. of the Geol. Soc.* I. p. 451. BAUERMAN, *Ibid*, XXII. pp. 448-63. JACKSON, *Geological and Mineralogical Reports*, Passim. FOSTER & WHITNEY, *Geological Report*, pp. 58—186. *Ante*, pp. 411—63, *Tables XII.—XIV.*).

At *Lac la Belle*			
the temperature of the air at the surface	.....	was.....	71°
,, ,, in the upper *level*	..	,, ...	47·
,, water ,,	..	,, ...	44·
,, air at 23·3 fms. deep	..	,, ...	51·
,, water ,, ,,	..	,, ...	44·
,, air 30· ,,	..	,, ...	48·
,, water ,, ,,	..	,, ...	45·
At *Copper Falls*—			
the temperature of the air at the surface	..	was.....	42·
,, water at 3·3 fms. deep	..	,, ...	44·5
,, air ,, 20· ,,	..	,, ...	49·
,, water ,, ,, ,,	..	,, ...	44·5

during winter * —often frozen as they issue, at considerable depths, from the rocks and *lodes* through which they had percolated. Thus, the streams which had entered at *Toltec* mine,† at 16·6 and at 23·3 fathoms, and the *Douglas Houghton (Henwood)* ‡ mines at 36 fathoms from the surface, during the autumn of 1855 and become frozen during the succeeding winter, were yet unthawed in the following July.

THE CHANNEL ISLANDS.

SARK.

The metalliferous rocks of Sark consist, in great measure, of felspar and hornblende,§ associated with

---

At the *North American* mine—								
the temperature of the air at the surface							was	59°
,,	a spring of water 16· fms. deep						,,	43·
,,	water	20·5	,,	,,			,,	45·
,,	,,	26·	,,	,,			,,	44·
At *The Cliff* mine—								
the temperature at the surface							was	46·
	10· fms. deep							44·

smaller proportions of several other substances. The *lodes* which traverse them contain great quantities of the same ingredients; mixed, largely, with quartz and calcareous-spar, and, less plentifully, with earthy brown iron-ore, iron-pyrites, and yellow copper-ore. At the S.S.W. extremity of the island, however, the *Sark's-Hope lode* afforded also argentiferous and antimoniated galena, the super-sulphuret, sulphate, sulphato-tricarbonate, and carbonate of lead, together with the chloride of silver, earthy black silver-ore, as well as vitreous, red, and native silver,* where it was wrought beneath the sea.

The temperature of Sark is probably much the same as that of Guernsey, which ranges from 24°·5 to 83°,† and averages 51°·6.‡

The undermentioned temperatures were observed at different depths in various parts of the island:—

Windmill Hill.	Depth.		Temp.
Well of fresh water (1841, January 26th§)	Surface.	.....	47°·‖
Port ès Sées.	Depth below the surface. fms.	Relation to the sea-level. fms.	
Small stream of fresh water, out of the rock.....	42·	16· A	55·
Large ,, ,, , ,, *lode*	54·	4· A	58·7

p. 101. Ansted, *Channel Islands*, pp. 263—6. *Ante*, pp. 530—2, *Table XVII.*, *Fig.* 30.

* Prince, *Cornwall Geol. Trans.*, VI. p. 102. *Ante*, p. 535, *Table XVII.*

† Ansted, *Channel Islands*, p. 140.

‡ *Ibid*, p. 134.

§ From 1843 to 1858 the temperature at Guernsey during the month of January has ranged from 24°·5 to 54°·5, and averaged 43°·6.—ANSTED, *Channel Islands*, pp. 134—7.

‖ "Some years ago, a level connected with mining operations then going on,

Le Pot.	Depth below the surface. fms.	Relation to the sea-level. fms.	Temp.
Moderate stream of fresh water, out of the rock..	47·	12· A*	54°·
" " , " *lode* ..	55·	4· B*	56·
Sark's Hope Mine.			
Small stream of fresh water, out of rock and *lode*..	24·	4· A	55·5
Moderate " brackish " , " rock	44·	20· B	56·2
Large " " " , " "	54·	30· B	57·2
Small " " " , " *lode*	"	"	57·2
" " " " , " rock W.	64·	40· A	58·
Water, brackish, pumped to the *adit* (4 fms. above the sea) ..... from	"	"	56·

HERM.

The *Herm* mines were wrought, to a depth of thirty fathoms, in rocks composed mostly of white, pinkish, buff-coloured, and greenish felspar, mixed with much hornblende, and sometimes with quartz and mica.†

Two *lodes* respectively—

bear 10°—15° N. of E.—S. of W.,* dip N., and measure 5—30 feet in width;
„ 24° W. of N.—E. of S.,* „ E., „ 2—4 „ „ .

Both these,—and the numerous *(branches)* veins which separate from, and re-unite with, them, in various parts of their range,—also contain great quantities of felspar, hornblende, and quartz; iron-pyrites abounds, and small *(bunches)* masses of yellow copper-ore occur at intervals.

As Herm and Guernsey are but six miles apart, they can scarcely differ much in climate.†

The undermentioned observations were made in February, 1841; viz.—

	Depth below the surface. fms.	Relation to the sea-level. fms.	Temp.
Well of fresh water ‡	Surface.	10· A	48°·7
Small stream of fresh water out of *lode*	8·	2· B	49·5
Large „ „ rock at some distance	„	„	53·
Small „ „ *lode*	12·	8 B	55·2
Minute „ „ jetting out of *lode* within a short distance..	„	„	56·

IRELAND.

COUNTY OF WICKLOW.

The mines of *Connorree, Cronebane, Tigrony, Ballygahan,* and *Ballymurtagh* have afforded enor-

* In 1838 the Magnetic declination was about 24° W. Ross, *Phil Trans.*, CXXXIX. p. 208. SABINE, *Ibid, Pl. XIV. Ante,* p. 531, Note *.

† Ansted, *Channel Islands,* pp. 134,—7. *Ante,* p. 735. Note §.

‡ "Herm has good fresh water in natural springs, and in two places there is running water."—ANSTED, *Channel Islands,* p. 68.

mous quantities of iron-pyrites mixed with slaty matter, quartz, and various ores of copper,* from several beds of different widths which conformably interlie schistose rocks, presumed to be portions of the Silurian system.

At 3·1 † fms. above the sea at	Dublin the annual mean temperature from 1840 ‡ to 1851 §		was 50°·3.
& „ 5·6 † „	Courtown „ in 1851 ¶		

As Ovoca lies between Dublin and Courtown, it probably differs but little from them in climate.

Localities.	Depth below the surface. fms.	Relations to the sea-level. fms.	Temp. 1840. May.	Temp. 1840. Nov.
Connorree Mine.			°	°
Water, a well	Surface..	100· A	..	45·
„ a moderate stream out of clay-slate .	54·	75· A	..	49·5
„ „ the *Sulphur-course*..	„	„	..	50·
„ pumped to the surface ..... from	„	„	..	49·

inland and beneath the sea, in greyish-green, greenish-black, and mottled fossiliferous slates, interlaid by massive rocks of felspar, quartz, and chlorite, as well as by thin beds of ferruginous conglomerate.* The *lodes*—which have been very productive—consist, in great measure, of quartz, slaty matter, calcareous-spar, and chlorite, associated with earthy-brown iron-ore, iron-pyrites, earthy black copper-ore, vitreous copper, malachite, and copper-pyrites.† The *cross-veins*, which intersect both the rocks and *lodes*, are composed, mostly, of slaty-clay, and disintegrated felspar; but, at intervals, they contain spheroidal masses of quartz.‡

At Dunmore, some 12 miles E. of *Knockmahon*, the mean temperature of the year 1851 was.. 51°·6;§

& „ Waterford, „ 15 „ N.E. „ , the mean temperature from 1860 to 1868 was 50·3.‖

---

* Weaver, *Geol. Trans.*, v. p. 248. Du Noyer, *Explanation to accompany Sheets* 167, 168, 178, 179 *of the Geological Survey of Ireland*, p. 57. Baily, *Ibid*, p. 24.

† Hore, *Ibid*, p. 81. Du Noyer, *Ibid*, pp. 81—2. *Ante*, pp. 594—8, *Table XIX.*

‡ *Ante*, pp. 598—9, *Table XIX.*

§ Lloyd, *Trans. Royal Irish Academy*, XXII. pp. 416,—24.

‖ Observations made at Newtown, Waterford;—

Years.	Maximum.	Minimum.	Mean.
1860	78°·	14°·	50°·
1	82·	25·	52·2
2	76·	20·	50·6
3	80·	28·	50·3
4	81·	19·	48·9
5	86·	20·	48·6
6	85·	20·	49·2
7	79·	16·	50·4
8	86·	28·	52·3
Extremes	86·	14·	
Mean	—	—	50·3

R. J. GREER, ESQ., of Newtown, Waterford, MSS.

The undermentioned observations were made at *Knockmahon*;*—

	Depth below the surface. fms.	Relations to the sea-level. fms.	Temp.
			°
Water, a well (29th April, 1840)	1·6	3. A	48·
„ issuing from the clay-slate and the *lode* ..	16·	3. A	48·7
„ accumulating from several small streams out of the *lode*	112·	93· B	57·5
„ pumped to the adit (3 fms. above the sea) from..	„	„	50·5

COUNTY OF CORK.

The *Bearhaven* mines are opened in rocks, of the

* "Thermometers were placed, in August 1843, in the deepest part of Knockmahon Copper Mine; * * * one being sunk three feet into the rock, and another into the lode at a depth of [129 fathoms] from the surface. A thermometer * * * was hung in the gallery or level where these were placed. * * *

"These mines are in lat. 52° 8′ N. and the mean annual temperature at the surface calculated by the usual formula would, therefore, be 50°·026.

"The general average of the thermometers at the depth of [129 fathoms],

Carboniferous slate series,* composed of siliceous matter mixed with chlorite, talc, or some similar mineral; at intervals, however, they contain small quantities of the carbonate of lime; whilst all parts of them are intersected by minute veins of quartz. Near rich portions of the *lodes* they are usually lilac, pale-buff, or dove-coloured, and of thick-lamellar structure; but elsewhere they are blue and fissile. The *lodes* consist mostly of quartz, but contain also chloritic or talcose matter, beside smaller proportions of the carbonates of lime and of iron; moreover, they include angular *(horses)* masses of slate without number. Iron-pyrites, vitreous copper, and malachite occur now and then, but copper-pyrites is the prevailing ore.† A *cross-vein* —composed of slaty-clay in other parts of its range— becomes highly quartzose as it intersects the *Main* (Mountain) *lode.*‡

At Castletownsend, some 40 miles E.S.E., the mean temperature of the year 1851 was	52°·1;§
„ Cahirciveen, „ 22 „ N.N.W., „ „ „	52·3.§

The mean annual temperature at the *Bearhaven* mines, therefore, is probably much the same.

The temperatures observed at different depths have been,—

---

* Jukes & Kinahan, *Explanation to accompany Sheets* 197 *and* 198 *of the Geological Survey of Ireland*, pp. 13, 20. *Ante*, p. 602, *Table* XX.

† Smyth, *Explanations to accompany Sheets* 197 *and* 198 *of the Geological Survey of Ireland*, pp. 30—3. *Ante*, pp. 603—8, *Table* XX.

‡ *Ante*, p. 608, *Table* XX.

§ Lloyd, *Trans. Royal Irish Academy*, XXII. pp. 416,—23.

	Depths below the surface. fms.	Relation to the sea°-level. fms.	Temp.
Water oozing out of a rock N. of *Main Lode*	128·	60· B	58·5°
„ „ *Main lode*	140·	72· B	61·5
„ pumped to the *adit* (20 fms. above the sea) from..	„	„	56·

COUNTY OF KERRY.

The *Ardtully* mines were worked in, and between, reddish-purple, greenish-grey, yellowish-green, lead-coloured, or mottled, slates; † and greyish Carboniferous limestone in which crinoidal remains are not uncommon.‡ Small beds of slaty-clay, quartz, and earthy brown iron-ore, slightly sprinkled with iron-pyrites and yellow copper-ore, occur in the slate; § whilst irregular bands of calcareous-spar—here and there charged with grey and purple copper, slightly mixed with copper-pyrites, and enclosing, at intervals, small bodies of peculiar (? organic) character—merge

metalliferous deposit, however, intersects the slate in one part of its range, but separates the slate from the limestone in another. Where both sides (*walls*) are of slate shallow portions of the matrix consist of slaty clay mingled with earthy brown iron-ore, enclosing nodules of hematite, and angular masses of slate often encrusted with copper-pyrites, together with grains of purple, grey, and native copper; at greater depths siliceous slate—the principle ingredient—is frequently veined with quartz and speckled with copper-pyrites; moreover, where opposite sides of the deposit are bounded by rocks of different kinds, that portion of it which adjoins the slate—although rather richer—maintains, in other respects, its normal character; at its contact with the limestone, on the contrary, it comprehends ill-defined beds of grey limestone and calcareous spar which embed considerable quantities of grey and purple copper, with smaller proportions of copper-pyrites.*

Kenmare is about thirty miles N.N.W. of Castletownsend, and
about twenty-eight „ E. by S. of Cahirciveen;

but, inasmuch as it is less open to the ocean and more enclosed by mountains than they are, any difference between its mean temperature and theirs,† may, perhaps, be rather in defect than excess.

Whilst the *Ardtully* mines were deepened, observa-

* Haughton, *Journal of the Geol. Soc. of Dublin*, VI. pp. 212—13. Du Noyer, & Willson, *Explanations to accompany Sheet* 184 *of the Geological Survey of Ireland*, p. 37. *Ante*, pp. 616—19, *Table XXI.*

† Lloyd, *Trans. Royal Irish Academy*, XXII. pp. 416,—23. *Ante*, p. 741.

tions were made, at various times, in different parts of them, with the undermentioned results.

Localities.	Depth below the surface. fms.	Temperature. 1840. October.	Temperature. 1841. June.
North, Engine, or *Ardtully, lode.*			
Water, a small stream oozing out of slate in the N. side *(wall)* (*a*)..	17·	50°·6	°
„ , „ „ *lode* W. (*b*) ..	„	51·25	
„ , a large stream out of slate (*a*)	20·	..	53·
„ , „ „ *lode* (*b*)	22·	51·25	
„ , „ „ „ (*b*)	27·	..	55·
„ , pumped to the surface.... in 1840 from..	22·	51·	
„ , „ „ .... „ 1841 „ ..	27·	..	53·

ENGLAND.

CORNWALL.

THE CARADON DISTRICT,—

which rises from about 600 to 1,200* feet above the

smaller proportions of several other substances. The *lodes* which traverse them contain great quantities of the same ingredients; mixed, largely, with quartz and calcareous-spar, and, less plentifully, with earthy brown iron-ore, iron-pyrites, and yellow copper-ore. At the S.S.W. extremity of the island, however, the *Sark's-Hope lode* afforded also argentiferous and antimoniated galena, the super-sulphuret, sulphate, sulphato-tricarbonate, and carbonate of lead, together with the chloride of silver, earthy black silver-ore, as well as vitreous, red, and native silver,* where it was wrought beneath the sea.

The temperature of Sark is probably much the same as that of Guernsey, which ranges from 24°·5 to 83°,† and averages 51°·6.‡

The undermentioned temperatures were observed at different depths in various parts of the island:—

Windmill Hill.	Depth.		Temp.
Well of fresh water (1841, January 26th§)	Surface.	.....	47°·‖
Port ès Sées.	Depth below the surface. fms.	Relation to the sea-level. fms.	
Small stream of fresh water, out of the rock.....	42·	16· A	55·
Large ,, ,, , ,, *lode*	54·	4· A	58·7

p. 101. Ansted, *Channel Islands*, pp. 263—6. *Ante*, pp. 530—2, *Table XVII.*, *Fig.* 30.

* Prince, *Cornwall Geol. Trans.*, VI. p. 102. *Ante*, p. 535, *Table XVII.*

† Ansted, *Channel Islands*, p. 140.

‡ *Ibid*, p. 134.

§ From 1843 to 1858 the temperature at Guernsey during the month of January has ranged from 24°·5 to 54°·5, and averaged 43°·6.—ANSTED, *Channel Islands*, pp. 134—7.

‖ "Some years ago, a level connected with mining operations then going on,

Localities.	Rocks	Depth below the surface. fms.	Relation to the sea-level. fms.	Temp.
Gonamena.				
Water in the *adit*, a very large stream out of the (*Country*) rock and *lode;* taken for household use in the neighbourhood, as it flows out at the surface	Granite.	20·	130· A	51°·4
South Caradon.				
Water, a very large stream out of the *Little Cross-course*..	Granite.	44·	96· A	51·4
" , pumped to the *adit* (14 fms. below the surface) .... from..	"	128·	12· A	61·5
The Phœnix Mines.				
Water, oozing out of the *(Country)* rock and *lode* at the bottom of the mine.	Granite.	146·	14· A	67·
" , pumped to the *adit* (26 fms. below the surface) ..... from..	"	"	"	52·6
Marke Valley.				
Water, a small stream out of *Sarum lode* (*back* of *level*)	Slate ..	106·	14· A	60·5
" , " (*bottom* ")	"	"	"	62·5

numerous small cavities filled with earthy ferruginous matter (? of organic origin *); in some places the slate encloses, but in other it is interlaid by rocks of felspar and hornblende,† occasionally of schistose, though usually of massive, structure.‡ The only *lode* yet discovered in the neighbourhood has afforded, and—at more than two hundred and fifty fathoms deep—still continues to afford, great quantities of argentiferous galena § and smaller proportions of other, less valuable, ores. Barren *(flucans)* veins of clay ‖ *(heave)* displace the *lode* in several parts of its range.

During the years 1833—1837 the mean temperature at Plymouth, some eleven miles S.E., was 52°·081.¶

Streams derived from various parts of the slate series have—at different times—shown the temperatures hereafter mentioned.

---

p. 39. Sedgwick, *Quarterly Journal of the Geol. Soc.*, VIII. pp. 5, 17, 146. Giles, *Cornwall Geol. Trans.*, VII. p. 201. Webb & Geach, *History and Progress of Mining in the Caradon and Liskeard District*, p. 38. Salmon, *Mining and Smelting Magazine*, II. p. 211. Holl, *Quarterly Journal of the Geol. Society*, XXIV. p. 423. *Ante*, pp. 700—4.

* *Ante*, p. 700.

† Rogers, *Cornwall Geol. Trans.*, II. p. 221. Boase, *Ibid*, IV. p. 211. Henwood, *Reports of the Royal Institution of Cornwall*, XXXIII. p. 39. Giles, *Cornwall Geol. Trans.*, VII. p. 201. *Ante*, pp. 701—2.

‡ *Ante*, pp. 701—2.

§ Henwood, *Reports of the Royal Institution of Cornwall*, XXXIII. p. 40. Giles, *Cornwall Geol. Trans.*, VII. p. 203. Salmon, *Mining and Smelting Magazine*, II. p. 218. Webb & Geach, *History and Progress of Mining in the Caradon and Liskeard District*, pp. 26, 36. *Ante*, pp. 703—14; *Tables XXVII.—VIII.*

‖ Henwood *Reports of the Royal Institution of Cornwall*, XXXIII. pp. 40,—2. Webb & Geach, *History and Progress of Mining in the Caradon and Liskeard District*, p. 37.

¶ Harris, *Reports of the British Association*, VII. pp. 24—5, *Pl.* X. *Ante*, p. 745.

Localities		Depth below the surface. fms.	Relation to the sea-level. fms.*	Temp.
Liskeard.†				°
Water in a closed well at the London Inn....	.. 1851, Sept 16th.	0·6	73· A	53·2
" Dean's (closed) well	.. 1867, July 30th.	1·	71· A	54·
Menheniot.				
Water in an open well, midway between the Church and *Wheal Mary Ann*	1867, July 29th.	Surface.	65· A	54·7
South Wheal Trelawny.				
Water, a small stream out of veins		53·	about sea-level.	56·5
" pumped to the *adit* (13 fms. deep) .. from		73·	20· B	56·5
Wheal Mary Ann.‡				
Water, a large stream out of *lode*, bottom of the mine ..	1851, Sept. 9th.	98·	48· B	67·5
" pumped to the surface ..	1867, July 29th from..	280·	230· B	64·5
Wheal Trelawny.§				
Water, a moderate stream out of	1851, Sept. 8th	68·	18· B	60·

and consists of calcareous slates, which sometimes contain organic remains.* The *lode* at *Herod's-foot* —the only one yet wrought to advantage—has yielded, and still yields, an abundance of argentiferous galena, and *bunches* of copper-pyrites, beside smaller quantities of several other ores.† The *lode* is *(heaved)* displaced by a cross- *(flucan)* vein; which consists mostly of schistose matter, but is, at intervals, thinly sprinkled with ore.‡

In climate, *Herod's-foot* can scarcely differ much from Plymouth, Caradon, and Menheniot.§

The undermentioned temperatures have been observed in different parts of the district:—

Localities.		Depth below the surface. fms.	Relation to the sea-level. fms.‖	Temp.
Duloe.				°
Water in an open well at Benoke ..	1851, Sept. 18th	Surface	33· A	55·4
Saint Keyne.				
Water in an open well ¶	1851, Sept. 18th	Surface	25· A	55·4
Herod's-foot.				
Water, a large stream out of the *lode* S.	1851, Sept 15th	137·	110· B	67·5
„ pumped to the surface....	1867, July 27th from..	160·	135· B	61·

* Giles, *Cornwall Geol. Trans.*, VII. pp. 97—9, 171. Peach, *Ibid*, p. 104. Sedgwick, *Quarterly Journal of the Geol. Society*, VIII. pp. 5, 17. Holl, *Ibid*, XXIV. p. 423. *Ante*, p. 700.

† Giles, *Cornwall Geol. Trans.*, VII. pp. 201—3. Salmon, *Mining and Smelting Magazine*, II. pp. 211—17. Webb & Geach, *History and Progress of Mining in the Caradon & Liskeard District*, pp. 16—18. *Ante*, pp. 705—15; *Table XXIX.*

‡ *Ante*, pp. 715—18, *Table XXIX.*

§ Harris, *Reports of the British Association*, VII. pp. 24—5. *Ante*, pp. 745,—7.

‖ Approximate.

¶ Carew, *Survey of Cornwall* (1602) f. 130. Norden, *Speculi Britanniæ Pars.* p. 86. Southey, *Poetical Works.* p. 656. Blight, *Ancient Crosses and other Antiquities in the East of Cornwall*, pp. 90—2.

SHROPSHIRE.

At *Eardiston*, some five miles S.E. of Oswestry, the New Red Sandstone and a band, varying in width from a few inches to perhaps five feet, by which it is intersected, both consist, in great measure, of granular quartz; but, whilst the former is tinged, more or less deeply, by various proportions of ferruginous matter, the latter contains, at intervals, great quantities of earthy brown iron-ore, sometimes largely mixed with the green carbonate of copper, and occasionally thinly sprinkled with grey copper-ore.* At a depth of sixteen fathoms, however, the iron-ore is replaced by blue clay, when all trace of copper-ore suddenly disappears.

A narrow ferruginous *cross-vein* intersects the whole formation; but occasions no *(heave)* displacement.

At Whittington, about five miles N.N.W. of *Eardiston*, the temperature, — between March 1842 and February 1843,— ranged from 11° to 81°, and averaged about 49°·7.†

At *Eardiston* on the 17th—18th of November, 1842—

water at the surface..... was frozen;

„ issuing from the metalliferous band at 15 fms. deep, had a temperature of } 54°;

„ pumped to the surface ..... from 16 „ „ , „ 50°;

It may, perhaps, be desirable, to place the facts, already described, in such various points of view, as may disclose their respective peculiarities.

The mean depths of the mines in *each district*;—

„ „ temperatures „ „ ;—

„ „ *ratios* of increase in temperature, expressed in fathoms of descent requisite to an elevation of one degree; * .... } „ „ ;—

„ „ annual temperatures at the surface.... } „ „ ;—

are set forth in the following columns:—

Countries.	Provinces & Districts.	Underground.			Surface.
		Mean depth. fms.	Mean temp.	Mean ratios. fms.	Mean annual temp.
CHILI	Chañarcillo	155	69°·2	21·6	64°· †
BRAZIL	Minas Geräes	53	67·9	26·2	60·49 ‡
UNITED STATES ..	Virginia.....	15	56·8	§	55· †

For the foregoing extracts, from a *Meteorological Register* which extends from March 1842 to July 1851, the writer is indebted to the Reverend Albany Rossendale Lloyd of Hengoed and George James Symons, Esq., F.M.S., Editor of "*British Rainfall.*"

* Henwood, *Cornwall Geol. Trans.*, v. p. 404.

† Keith Johnston, *Atlas of General Phænomena, Pl. XVIII. Ante*, p. 724.

‡ *Ante*, pp. 726—8,—9,—32. *Tables* XXX.—XXXI.

§ One observation only.

Countries.	Provinces & Districts.	Underground. Mean depth. fms.	Mean temp.	Mean ratios. fms.	Surface. Mean annual temp.
CHANNEL ISLANDS	Sark & Herm	37	55°·5	10·	51°·6 *
IRELAND.....	Wicklow, Waterford, Cork, & Kerry ..	57	53·4	14·1	50·3 † 52·3 †
ENGLAND	Cornwall	92	62·5	5·8 ‡	52·08 §
	Shropshire	15	54·	‖	49·7 ¶

Other details appear in *Table XXXII.*

The mean—depths,—temperatures,—and ratios in which the temperatures increase with the depths, in

---

* Ansted, *Channel Islands*, p. 140. *Ante*, p. 735.

† Lloyd, *Trans. Royal Irish Academy*, XXII. pp. 416,—22,—3,—4. *Ante*, pp. 738,—9,—41,—3. R. J. Greer, Esq., MS. *Ante*, p. 739.

‡ In the principal mining districts of Cornwall and Devon four hundred and fifteen observations afforded the undermentioned results:—

Districts.	Mean depth. fms.	Mean temp.	Mean ratios.	Districts.	Mean depth. fms.	Mean temp.	Mean ratios.

the *different rocks* of the several districts already mentioned, appear in the following pages:—

Rocks.	Mean depth. fms.	Mean temp.	Mean ratios.
New Red Sandstone*	15	54°.	One observation only.

* "New Red Sandstone [is] very much affected in its conductivity by being saturated with moisture.

Two blocks,—of which the second was the harder,—possessed the undermentioned powers of conduction when in different conditions;—

	1.	2.
Dry	25	49
Saturated with moisture....	60	62 65

HOPKINS, *Phil. Trans.*, CXLVII. pp. 808,—18,—19.

At the mine of *Monk-Wearmouth*—which was sunk,—
264· fms. beneath the surface,
249·5 „ „ sea,
to the coal-seams which underlay the magnesian limestone of Durham—
the mean temperature at the surface ..... was .. 47°·6
„ „ the depth of 264 fms. „ .. 72°.6
If, therefore, the depth of the invariable plane be taken at „ 16·6 „, we have an increase of temperature equal to one degree for 9·9 fms. of descent.

PHILLIPS, *London and Edinburgh Phil. Mag.*, V. pp. 446—51 (Abridged).

The coal-mine of *Torcy* (Department of Saône et Loire)—
was opened at ..... 169·3 fms. above the sea;—and
„ sunk ..... 155·9 „ below „ ;—
the total depth thus being ..... 325·2 „ „ the surface.
The annual mean of the climate ..... was 48°·5;
„ temperature maintained at 303 fms. deep, in an abandoned part of the mine ..... „ 81°.

The works of Mouillelonge, some two miles distant,—
were commenced ..... at 175·3 fms. above the sea;
and—having pierced the New Red Sandstone—entered the Coal-measures ..... „ 20·7 „ below „ ;
they were continued, however..... 250· „ deeper;—
reaching eventually a depth of 207·7 fms. below the sea, or..... 446· „ beneath the surface,
where the temperature ..... was 100°·9.

Now the difference
between the annual mean at *Torcy*, and the temperature at 303 fms. in the mine ..... was 32°·5 (1);—
„ „ „ 446 „ in *Mouillelonge* „ 52°·4 (2);—
„ 333 fms. at *Torcy* „ „ „ „ „ „ 19°·9 (3).

Rocks.	Mean depth. fms.	Mean temp.	Mean ratios.
Limestones alternating with Felspathic and Hornblendic rocks	155	69°·2	21·6

The ratio in which the temperature increases with the depth was—
in the first case, one degree for 9·2 fms.;—
" second " , " 8·5 " ;—
" third " , " 7·2 " .
(WALFERDIN, *Comptes Rendus*). SMYTH (Annual Address), *Quarterly Journal of the Geol. Soc.*, XXIV. pp. lxxix.—lxxx. (Abridged).

The *Duckinfield* colliery afforded rare opportunity for observing, in two shafts, the gradual increase of temperature with depth. Of the observations made by F. D. Ashley, Esq., the proprietor, a synopsis is presented in the following columns:—

FIRST SHAFT.					SECOND SHAFT.				
Extremes.		Means.			Extremes.		Means.		
Depth. fms.	Temp.	Depth fms.	Temp.	Ratios.	Depth. fms.	Temp.	Depth. fms.	Temp.	Ratios.
2·8	51°·	59·1	54°·4		83·7	58°·	95·8	58°·2	
115·5	57·7			18·5	119·7	59·			
117·3	58·								34·

Rocks.	Mean depth. fms.	Mean temp.	Mean ratios.
Felspathic and Hornblendic Rocks	37	55°·5	10·

It appears therefore, that the rocks in these neighbouring shafts maintain different temperatures at corresponding depths; and that at various parts—of even the same shaft—the temperatures increase, with the depths, in widely different ratios.

At the first shaft, indeed,

At the second shaft— 52 observations were made, and in 17 of them / 18 „ „ , „ 2 „ } the temperatures at the lower exceeded those at the upper stations;

of these differences, however, only one amounted to one degree and a quarter, whilst most of the others were much smaller.

Nevertheless, that the temperature increases at an average of one degree for a descent of

14·8 fathoms in the first shaft, and of
16·8 „ „ second „ ,

is indisputable.

FAIRBAIRN, *Report of the British Association*, 1861, Part II. pp. 53—6. (Paraphrased and abridged.)

The Rose Bridge collieries, at Ince near Wigan, have afforded opportunity for the undermentioned observations :—

Depth, fms.	Temperature.	Ratios.	Depth, fms.	Temperature.	Ratios.
80·5	64°·5		339·5	87°·	
100·	66·	13·	367·	88·5	18·3
279·	78·	14·9	372·5	89·	11·
302·5	80·	11·7	380·5	90·5	5·3
315·	83·	4·1	387·5	91·5	7·
331·5	85·	8·2	391·5	92·	8·
335·5	86·	4·	400·	93·	8·5
339·5	87·	4·	403·	93·5	6·

From 80·5 to 403 fathoms therefore the increase of temperature averages one degree for 11·1 fathoms.

For this interesting record the writer is indebted to
JOHN ARTHUR PHILLIPS, ESQ.

In the Coal-mines of Virginia, which are believed to be of the Oolitic period (LYELL, *Quarterly Journal of the Geol. Soc.*, III. p. 261), Professor W. B. Rogers observed that

from 66 to 100 fms. deep the increase of temperature amounted to 4°·5 or at the rate of 1 degree in 7·5 fms.;
„ 100 „ 130 „ „ „ 2·5 „ „ 12· „ ;
„ 66 „ 130 „ „ „ 7· „ „ 9·1 „ .

D'ARCHIAC, *Histoire des Progrès de la Géologie*, I. p. 71.

Rocks.	Mean depth. fms.	Mean temp.	Mean ratios.
Clay-slate*	70	61°·8	11·3
Jacotinga †	40	67·3	—
Talcose, micaceous, and chloritic slates	18	62·9	‡
Granite*	79	59·5	5·8

The mean — depths,—temperatures,—and rates at which the temperatures increase with the depths — of the mines which yield *different metals and ores (Table XXXIV.)*, are—

Metals and Ores.	Mean depth. fms.	Mean temp.	Mean ratios.
Gold	51·	67°·5	23·
Silver	155·	69·2	21·5
Lead	72·	60·7	8·4
Copper §	43·	53·7	15·9

* From one hundred and thirty-four observations, in the mines of Cornwall,

Metals and Ores.	Mean depth. fms.	Mean temp.	Mean ratios.
Copper and Tin* ..	114	65°·7	—†

But whilst *Morro Velho* and *Gongo Soco* have been rich in gold, by far the larger part of the auriferous deposits have consisted of iron-pyrites in one, and of specular iron-ore in the other. Moreover, in the *lodes* which yield copper-ore,—whether mixed or unmixed with the oxide of tin,—iron-pyrites always abounds.

Between the temperatures and ratios observed, at various depths, in mines which have afforded *similar metals and ores in rocks of different character*, as well as between the temperatures and ratios noticed in such other mines as have yielded *different metals and ores in rocks of like nature*, the following comparisons have been made *(Table XXXV.)*:—

---

than those which yielded copper."—*Annales et de Chimie et de Physique*, XVI. p. 80; *Edinburgh New Phil. Journal*, XXIV. p. 140.

"The tin mines of the *Sauberg* at *Ehrenfriedersdorf* also show a remarkably low temperature; indeed it is a prevailing opinion that stanniferous mountains are colder than others."—REICH, *Beobachtungen ueber die Temperatur des Gesteins in verschiedenen Tiefen in den Gruben des Sachsischen Erzgebirges*, pp. 87, 107. BISCHOFF, *Edinburgh New Phil. Journal*, XXIV. p. 140.

The following are the mean depths at which observations were made, and the mean temperatures observed in the *lodes* affording different ores in the principal mining districts of Cornwall and Devon.

Lodes.	Mean depth, fms.	Mean temperature.
Copper	140	72°·39
Copper and Tin	74	61·45
Tin	92	60·67

HENWOOD, *Cornwall Geol. Trans.*, V. p. 404.

* *Ante*, p. 756, Note §.

†Means of five observations, but all at the same horizon.

Rocks.	Metals and Ores.								
	Gold.			Lead.			Copper.		
	Mean depth fms.	Mean temp.	Mean ratios.	Mean depth fms.	Mean temp.	Mean ratios.	Mean depth fms.	Mean temp.	Mean ratios.
New Red Sandstone	..	..	..	..	..	..	15	54°	*
Felspathic & Hornblendic rocks ..	..	..	..	48	56°·8	13·5	30	54°·7	9·4
Clay-slate	67	68°·4	25·2	93	63·6	10·7	57	53·4	14·1
Jacotinga	42	67·3							
Talcose and Micaceous slate	18	62·9	†						
Granite	..	..	..	..	..	..	32	51·4	†
Means	51	67°·8	23·	72	60°·7	8·4	43	53°·7	15·9

Amongst the mines described in foregoing pages, those which have yielded silver and gold occupy high ranges of mountains, within the tropics; whilst such as have afforded the ores of other metals have been

As far as these observations extend, therefore, it appears that at considerable altitudes within the tropics, the temperature is higher than at corresponding levels below the surface at smaller elevations in temperate regions; but that the ratio at which it increases with the depth is much less rapid in the former than in the latter.

The mean—depths,—temperatures,—and ratios at which the temperatures increase with the depths, of the mines before mentioned, irrespective of their geographical positions, altitudes, rocks, metals and ores,—are the following:—

Extreme depth, fms.	Mean depth, fms.	Mean temp.*	Mean ratios.*
Surface to 50 ..	28	61°	21·4
50 „ 100 ..	65	60·5	
100 „ 150 ..	122	65·4	
150 „ 200 ..	155	72·	5·
200 and beyond .	227	73·2	60·
Means	62	62·3	16·3

less rapldly than it has been found to increase in the similar rocks of Cornwall. HENWOOD, *Proceedings of the Royal Geol. Soc. of Cornwall*, 24th Oct. 1865.

At *Morro Velho* in Brazil the rate at which the temperature increases is but one degree for (33·3 fathoms) 200 feet.—SMYTH, *Quarterly Journal of the Geol. Soc.*, XXIV. (1868) p. lxxxvi.; *Ante*, p. 727.

* One hundred and thirty-four observations in the mines of Cornwall and Devon afforded—between 1830 and 1837—the following results:—

But at great altitudes in tropical regions—where the temperatures are above, whilst the ratio is below, the average,—and at smaller elevations in temperate climates,—where the ratios exceed, whilst the temperatures fall short of it,—observations have not been made

	ROCKS.					
	SLATE.			GRANITE.		
Extreme depth. fms.	Mean depth. fms.	Mean temp.	Ratios. *a*	Mean depth. fms.	Mean temp.	Ratios. *a*
Surface to 50	35	57°·	8·8	31	51°·6	11·4
50 „ 100	73	61·3	8·1	79	55·8	5·6
100 „ 150	127	68·	4·3	133	65·5	6·6
150 „ 200	170	78·	6·1	—	—	
200 and beyond..	221	85·6		237	81·3	
Means	.....	.....	6·5	.....	.....	6·9

HENWOOD, *Thomson's Records of General Science*, IV. (1836), p. 198;

in the same proportions at different depths. Thus,—

Extreme depth, fms.	Observations in elevated tropical regions.	Observations at moderate altitudes in temperate climates.
Surface to 50	24	17
50 „ 100	5	12
100 „ 150	4	10
150 „ 200	2	—
200 and beyond..	2	—
Totals	37	39

deepest, of many mines in Cornwall and Devon, exhibit increments of temperature equal to 10° each at intervals of about 47, 79, and 125 fathoms of descent.

Whilst fifty-three experiments in the deepest levels or accessible parts of mines show the rock, water, and air to preserve in round numbers,—

	a temperature of 60°	at 59 fms.	below the surface;		
	„ 70	„ 132 „	„ ;		
and	„ 80	„ 239 „	„ ;		
being an increase of	10	„ 59 „	„ ;	or 1° in 6.	fms.
„	10 more	„ 73 „	.. deeper;	„ 7·3	„ ;
„	10 „	„ 114 „	still deeper;	„ 10·7	„ .

Fox, *Reports of the British Association*, for 1840, pp. 310—16 (Abridged.)

The following columns show the respective ratios of increase in temperature expressed in fathoms of descent requisite to produce an elevation of one degree; deduced from four hundred and fifteen observations in the mines of Cornwall and Devon:—

Depth. fms.	Granite. fms.	Slate. fms.	Rocks. fms.	*Cross-courses.* fms.	*Lodes.* fms.	Tin-*lodes.* fms.	*Lodes* yielding both tin and copper ores. fms.	Copper-*lodes.* fms.	Means. fms.
Surface to 50	9·3	5·	5·8	8·2	6·	8·6	6·5	4·6	6·8
50 „ 100	9·1	7·1	8·1	6·	8·3	7·3	6·4	8·5	7·6
100 „ 150	8·3	8·3	6·7	11·	7·8	8·5	10·5	8·	8·7
150 „ 200	..	4·4	3·7	4·9	6·3	..	3·	4·5	4·5
200 & beyond	7·5	6·5	9·5	3·9	5·2	5·1	..	6·5	6·4
Means ..	8·5	6·2	6·7	6·8	6·7	7·3	6·6	6·4	6·8

Henwood, *Cornwall Geol. Trans.*, v. p. 406; (D'Archiac), *Histoire des Progrès de la Géologie*, i. p. 69.

This preponderance of observation—
at less than 50 fathoms deep in elevated, tropical, regions;
from 50 to 150 „ „ in lower, temperate, countries;
and at all greater depths ... at great altitudes within the tropics,
accounts for the *apparently* higher temperature from the surface to fifty—than from fifty to one hundred—fathoms deep. Yet, whether unequal numbers of observations—in each of several countries so far apart,—at altitudes so various,—in rocks so different,—and in mines yielding so many metals and ores,—can afford results accurately representing the mean temperatures

---

The temperatures observed in the *rocks* or *lodes* at the *deepest levels*, and ratios at which the temperatures increase with the depths, of mines in various parts of Cornwal, are—

Mines.	Ores.	Rocks.	Date of observations.	Depth. fms.	Temp.	Ratios.
Botallack	Copper & Tin.	Slate ..	1837	188	79°·	6·5
		Slate ..	1853	255	87°·	6·9
Levant	Copper & Tin.	Granite..	..	..	74°·	10·6

and ratios on any one vertical line, may, perhaps, be open to question.

The composition and structure peculiar to different strata afford greater or less facility for the ascent of water and vapour; which, co-operating with the conducting power proper, in various degrees, to all rocks, —aid as well in transferring towards the surface of the earth some portion of the heat maintained within it, as in determining to each formation its due distribution of temperature. Occasionally, however, this normal equilibrium is disturbed by the miner;* through

---

United Mines, is one of a group of east and west [copper-] veins which are encased in the clay-slate or *killas*, on the east of the granite hill of Carn Marth. * * * The author found, in 1855, the chief spring welling upwards in a level 251·6 fathoms deep, with a temperature of 114°. * * * In [1864, however,] these parts of the workings had been laid dry by the extension of deeper galleries, and the point of egress of the springs was along the rich *lode*, advanced [much] farther eastward. * * * [In this part of the works] the principal body of the upward-flowing water was to be seen rising * * * on the north side of the magnificent *lode* of cellular, black-stained, cinder-like pyrites. The next *level* [at 270 fathoms below the surface] is advanced farther eastward by some 70 fathoms; the *lode* exhibited a good breadth of fine black-coated copper pyrites; and small feeders of water, issued mostly from the north, or *hanging-wall*, almost scalded the fingers holding the thermometer, which marked 122°. * * * At the bottom *level*, which is 275 fathoms deep; in its end the *lode* was narrow, and very impervious to water, but a little rill trickling from it showed a temperature of 121°. * * *

Between my last two visits * * * the point of issue of the hotter water had been deepened 30 fathoms, and the temperature was increased by 8°. This would give 1° for 3·75 fathoms. * * *

SMYTH, *Mining and Smelting Magazine*, VI. pp. 193—6; *Reports of the British Association*, for 1864, Part II. p. 70. (Abridged)

* "Numerous observations show that, whilst the conditions of the works on mines are unchanged, the temperatures at considerable depths are constant; but it seems not to have been ascertained whether the temperature of any spot —after other openings were extended beneath it—remained the same as it had been when it was the bottom of the mine. To invite enquiry on this subject, I venture to offer the following comparisons.

whose shafts and *(levels)* galleries, water and vapour circulate more freely than they had previously circulated through the cleavage-planes, joints, and crevices

---

East Wheal Crofty (a copper-mine, wrought in felspathic and hornblendic rocks :—

	1838.		1840.	
	Depth, fms.	Temp.	Depth. fms.	Temp.
Longclose, Engine-lode	85	63°·5	85	60°
" , "	..	..	115	64·
Trevenson, Reeve's Lode	115	69·	115	62·
" , "	..	..	135	70·75
Wheal Vor (a tin-mine, opened in clay-slate).	1838.		1859.[a]	
Main Lode, W.	..	..	210	74.5
" , W.	..	..	222	75·
" , E.	230	78·		
" , E.	240	80·5 / 81·	240	74·

in the rocks and *lodes;* as therefore, each successive extension of deeper works intercepts, in its turn, the ascent of warm currents, the temperature of the original bottom gradually declines.

That, here and there, portions of various rocks and vein-stones are cooler than those above them, seems too well authenticated to admit of question. Such, infrequent interpositions, however, are seldom of great vertical range, and there is reason to believe they have usually but small horizontal extent; moreover, between

---

at *Reeve's Lode*, the temperature
at the bottom..... was 69·° in 1838 when the works were 115 fms. deep;—
but it had, at the same
spot declined to .. 62· „ 1840 „ 20 „ deeper:—
yet at the bottom it had
risen to..... 70·75 „ „ „ 135 „ deep.

At *Wheal Vor*,
the temperature on the *Main Lode*
at the bottom..... was 80°·5 in 1838 when the mine was 240 fms. deep;—
but it had at the same spot
fallen to .... 74·[a] „ 1859 „ 81 „ deeper;—
nevertheless at the bottom
it had advanced to .. 91·[a] „ „ „ 321 „ deep.

HENWOOD, *Cornwall Geol. Trans.*, v. (1843), p. 395; *Reports of the Royal Institution of Cornwall*, XLI. (1859), pp. 21—3; *Annales des Mines*, 5me Série, XVI. pp. 571—3.

At *Wheal Vor*, on the 30th September 1858, the mid-day temperature
at the surface was .... 67°;
but at the bottom, 311 fms. deep, the air and the water issuing from
the rock were both at .... 80°.

SMYTH (Annual Address), *Quarterly Journal of the Geol. Society*, XXIV. p. lxxxv. (Abridged.)

"On comparing the results obtained in Dolcoath in 1821—2 and 1827, it appears that the temperature was increased only 4° in one level with an increased depth of 42 fathoms, giving a ratio between the stations of 1° increase in 10·5 fathoms; and in another level the temperature was actually 2° to 2°·5 less than in 1822, although 42 fathoms deeper than the mine was then."

FOX, *Report of the British Association*, for 1857, Part I. p. 100.

[a] *Ante*, p. 764, Sub-note.

their temperatures and the temperatures of the warmer rocks above and below them, the differences rarely exceed two degrees, and usually they are much smaller. Whether this state of things is a natural one,—or whether—in fact—it may have been brought about by the shafts, *levels*, and other openings in which it has been observed,—is beyond the scope of this enquiry.

W. J. HENWOOD.

3, CLARENCE PLACE, PENZANCE,
1870, FEBRUARY 3RD.

On the changes of temperature which take place—at the same, and at different, times,—on the surface and at depths of three, six, and nine feet in the Canga, *at* Agoa Quente *in Brazil*

The following observations were made with a view to ascertaining the rate at which solar heat penetrates the earth.

The high granitic ridge of the Caraça,* situate in Long. 43° 10′ W., Lat 19° 50′ S., is, on the W.S.W. —separated by a deep and narrow glen from a parallel, but less elevated, range consisting of talco-micaceous slate,† and schistose iron-glance interlaminated with quartz *(Itabirite* ‡*)*, in which—at least—one conformable bed of auriferous *(Jacotinga* § *)* manganese, iron-glance, and talc has been extensively wrought. Considerable portions of the talco-micaceous slate, as well as of the *Itabirite* and *Jacotinga*, are overlaid by *(Canga* ‖ *)* breccia, containing sub-angular masses of the selfsame rocks and of quartz, usually cemented by compact brown iron-ore, but sometimes imbedded in

---

* *Ante*, pp. 174—6.

† *Ibid*, pp. 176, 220.

‡ *Ibid*, pp. 214,—21,—44,—8,—98.

§ *Ibid*, pp. 173, 214,—16,—19,—23,—7,—36,—46,—51,—86, 303, 729.

‖ *Ibid*, pp. 216,—17,—36,—45,—99, 319,—24.

"The ground rang under the hoof as if iron-plated; * * * . The appearance of the mineral reminded me of the laterite in Malabar and Western India, but here it is the richest hæmatite."

BURTON, *Explorations of the Highlands of the Brazil*, I. p. 315.

reddle. Particles of gold * and nests of native copper * occur in the *Canga*, but too rarely to need further remark.

Some four hundred fathoms N.W. of, and perhaps sixty fathoms above, the works at *Agoa Quente*,†—that is to say about three thousand six hundred feet above the sea—the surface is partially clothed with a stunted coppice of *(Lychnophora) Candeia*; ‡ and at this spot holes §—of two inches in diameter and respectively of three, six, and nine feet in depth—were sunk in the *Canga*.

Thermometers—adjusted to the Standard of the British Association, by Pastorelli of London—were placed at the bottoms of the holes; which were then carefully closed with long wooden plugs wrapped in

* *Ante*, p. 236.

† *Ibid*, pp. 224—42, 729—31.

‡ "Sur plusieurs pentes couvertes de pierres, je trouvai en grande abondance

cloth; and—except for a minute or two at each read-

	Zupia. 8 pouces sous terre.	Dans l'air.
1830.		
Août le 3 à 9 h. m.	21°·4 C. .. 70°·5 F.	21°·7 C. .. 71° F.
10	21·4 .. 70·5	22·2 .. 72·
11	21·5 .. 70·7	22·2 .. 72·
1	21·5 .. 70·7	23·8 .. 74·8
3	21·5 .. 70·7	22·8 .. 73·
le 9 à 8 h. m.	21·4 .. 70·5	20· .. 68·
midi.	21·4 .. 70·5	23·3 .. 74·
5	21·4 .. 70·5	22·2 .. 72·
le 10 à midi.	21·4 .. 70·5	23·3 .. 74·
4	21·4 .. 70·5	23·5 .. 74·3
le 11 à midi.	21·4 .. 70·5	22·5 .. 72·5
le 12 à 9 h. m.	21·3 .. 70·3	20·5 .. 68·9
midi.	21·3 .. 70·3	21·1 .. 70·
le 13 à 9 h. m.	21·3 .. 70·3	20·6 .. 69·1
3	21·5 .. 70·7	22·6 .. 72·7
4	21·3 .. 70·3	23·9 .. 75·
le 15 à midi.	21·3 .. 70·3	22·8 .. 73·
le 16 à midi.	21·3 .. 70·3	22·8 .. 73·
3	21·3 .. 70·3	22·3 .. 72·1
le 18 à midi.	21·3 .. 70·3	24·4 .. 75·9
La boule du thermomètre a été placée à un pied au dessous de la surface du sol.		
le 18 à 3 h. soir.	21°·5 C. .. 70°·7 F.	23°·4 C. .. 74°·1 F.
4	21·5 .. 70·7	22·3 .. 72·1
6	21·5 .. 70·7	21·7 .. 71·
9	21·5 .. 70·7	22·2 .. 72·
le 19 à 9 h.m.	21·5 .. 70·7	21·1 .. 70·
midi.	21·5 .. 70·7	21·7 .. 71·
2	21·5 .. 70·7	22·8 .. 73·
3	21·6 .. 70·9	22·2 .. 72·
6	21·6 .. 70·9	22·2 .. 72·
le 20 à 11 h.m.	21·5 .. 70·7	21·1 .. 70·
midi	21·5 .. 70·7	21·7 .. 71·
3	21·5 .. 70·7	22·2 .. 72·
le 21 à 3 h.s.	21·6 .. 70·9	
5	21·5 .. 70·7	
le 22 à 9 h.m.	21·5 .. 70·7	
3 h.s.	21·6 .. 70·9	

ing of the instruments—they were never reopened.

"Pendant les mois de septembre, octobre et novembre, le thermomètre a toujours indiqué 21°·5 C. (70°·7 F.)

Marmato.

"Le thermomètre a été placé à 1 pied dans la sol, dans une salle basse de la maison du surintendant des mines. La température moyenne de cette maison déduite d'une année d'observations est de 20°·5 C. (68°·9 F.). Elle est élevée au-dessus de l'Océan de 1,426 mètres (4,679 feet).

	Thermomètre sous terre.	
1830.		
Septembre le 9 à 11 h.m.	20°·5 C.	68°·9 F.
1	20·5	68·9
3	20·5	68·9
le 10 à 8 h.m.	20·3	68·5
11	20·3	68·5
1	20·4	68·7
2	20·5	68·9
3	20·5	68·9

Anserma Nuevo.

"Des observations faites par Caldas, dans voisinage d'Anserma, donnent à cette partie de la vallée du Cauca,"—élevée de 1,050 mètres—(3,545 feet) "une température moyenne de 23°·8 C. (74°·8 F.).

"Le thermomètre placé à 1 pied de profondeur dans le sol d'un rez-de-chausée.

	Thermomètre sous terres.	
1830.		
Décembre le 16 à 8 h.m.	23°·8 C.	74°·8 F.

The temperatures observed at 6 A.M., noon, and 6 P.M., from the 22nd of May to the 13th of July 1849, in each of three holes;* and at 3, 6, and 9

Quito.

"La température moyenne de Quito,—élevée de 2,914 mètres (9,560 feet)—a été fixée par deux observateurs, MM. les colonels Hall et Salaza; leurs observations donnent une température moyenne de 15°·55 C. (60° F.).

"Pendant mon séjour à Quito, j'engage ai M. Salaza à suivre la marche de son thermomètre mis à 1 pied au-dessous de la surface du sol. Les observations furent faites dans une salle Casse.

Mois.	Dates	Thermomètre.							
		à 7 h. m.		à 11 h. m.		à 2 h. s.		à 4 h. s.	
1331. Septembre	26	15°·5 C.	59°·9 F.	15°·5 C.	59°·9 F.	15°·5 C.	59°·9 F.	15°·5 C.	59°·9 F.
	27	15·5	59·9	15·5	59·9	15·3	59·5	15·5	59·9
	28	15·3	59·5	15·5	59·9	15·5	59·9	15·5	59·9
	29	15·5	59·9	15·5	59·9	15·5	59·9	15·5	59·9
	30	15·5	59·9	15·5	59·9	15·5	59·9	15·5	59·9
Octobre	1	15·3	59·5	15·5	59·9	15·5	59·9	15·5	59·9
	2	15·5	59·9	15·5	59·9	15·5	59·9	15·5	56·9
	3	15·4	59·7	15·5	59·9	15·4	59·7	15·5	59·9
	4	15·5	59·9	15·5	59·9	15·5	59·9	15·5	59·9
	5	15·5	59·9	15·4	59·7	15·5	59·9	15·5	59·9
	6	15·5	59·9	15·5	59·9	15·5	59·9	15·5	59·9
	7	15·4	59·7	15·5	59·9	15·5	59·9	15·5	59·9

"Les observations que je viens de rapporter établissent, ce me semble, d'une manière certaine, que la température moyenne d'un lieu abrité situé entre les tropiques, est donnée par la température du sol prise à 1 pied de profondeur."

BOUSSINGAULT, *Annales de Chimie et de Physique*, LIII. pp. 228—35.

"La temperature de Rio-Janeiro a été evaluée, par M. E. Chevalier (*Voyage de la corvette 'la Bonite,'* p. 18), à 24°·2 C. (75°5 F.) d'apprès des observations faites à 1 pied de la surface du sol et à la profondeur de 3 mètres (9·8 feet), dans un puits."—D'ARCHIAC, *Histoire des progrès de la Géologie*, I. p. 88.

* Trevandrum is situate in Long. 5° 7′ 59″ E., Lat. 8° 30′ 32″ N.; the Observatory hill, which exposes a grassy surface, rises to about 200 feet above the sea, is composed of the stone called *Laterite*, and in this thermometers were placed at the respective depths of 3, 6, and 12 French feet (3·2, 6·4, and 12·8 feet English measure).

A.M., noon, 3, 6, and 8 P.M., and midnight, from the 1st of January to the 13th of July, at the surface, are compared in *Table XXXVII.*; whilst the highest, lowest, and mean temperatures during intervals of ten days each, in the same periods as shown in *Pl. VI.* and in the following columns.

The following columns contain the monthly means of observations made daily (except on Sundays) at 6 A.M., noon, 6 P.M., and midnight, as well on each of these thermometers as on others at the surface, from the 1st of May 1842, to the 31st of December, 1845.

Months.	Surface.	3 French, 3·2 English, feet.	6 French, 6·4 English, feet.	12 French, 12·8 English feet.
January ..	78°·930	84°·954	85°·618	85°·528
February ..	80·386	86·838	86·625	85·784
March	82·730	88·789	88·110	86·373
April	83·370	89·614	88·527 [a]	86·916
May	81·603	88·413	88·224 [b]	—
June	79·023	85·012	86·883	86·878 [b]
July	78·450	83·250	85·144	86·537
August	78·000	83·566	84·726	85·804

Periods.	Temperatures observed at the surface. Highest.	Lowest.	Mean.	depths of three feet. Highest.	Lowest.	Mean.	six feet. Highest.	Lowest.	Mean.	nine feet. Highest.	Lowest.	Mean.
1849.	°	°	°									
Jan. 1 — 10....	83·	65·	72·3									
„ 11 — 20....	84·3	61·	73·7									
„ 21 — 30....	84·8	62·	73·5									
„ 31 — Feb. 9.	79·5	63·	70·4									
Feb. 10 — 19....	81·5	56·	69·									
„ 20 — Mar. 1.	80·5	60·	73·									
Mar. 2 — 11....	80·5	64·	71·5									
„ 12 — 21....	78·	57·	68·9									
„ 22 — 31....	80·5	62·	70·									
April 1 — 10....	80·	62·	71·1									
„ 11 — 20....	77·	61·	68·4									
„ 21 — 30....	76·5	54·	65·1									
May 1 — 10....	70·	42·	59·3									
„ 11 — 20....	71·8	44·	61·9									
„ 21 — 30....	72·7	48·	61·5	73·7	72·1	72·8	71·6	70·6	71·3	71·8	71·1	71·4
„ 31 — June 9.	69·	50·	61·2	72·3	71·4	71·9	71·6	71·2	71·4	71·6	71·3	71·5
June 10 — 19....	73·4	43·	59·3	72·5	71·7	72·1	71·8	70·8	71·1	71·2	71·	71·1
„ 20 — 29....	70·2	50·	62·1	72·	71·1	71·5	71·2	70·8	71·	71·1	70·8	71·
„ 30 — July 9.	67·5	48·	57·7	71·9	71·1	71·5	..	..	..	71·	70·8	70·9
July 10 — 13....	68·	48·	57·8	71·3	71·2	71·3	..	..	..	70·8	70·7	70·8
January 1st to June 29th, Extremes	84·8	..	..	73·7	..	..	71·6	..	..	71·8		
	..	42·	..	..	71·1	..	..	70·6	..	..	71·	
Means	..	..	67·3	..	..	72·1	..	..	71·2	..	..	71·2
Ranges ..	42·8			2·6			1·			0·8		
January 1st to July 13th, Extremes	84·8	..	..	73·7	..	..	..	..	..	71·8		
	..	42.	..	..	71·1	..	..	..	..	..	70·7	
Means	..	..	66·3	..	..	71·9	..	..	..	..	..	71·1
Ranges ..	42·8			2·6			..			1·1		

At Brussels the temperatures hereafter mentioned are the means of ob-

From the 22nd of May to the 13th of July 1849, therefore, the extremes, the means, and the ranges of temperature were ;—

---

servations at different depths on opposite sides of the Observatory ; from 1834 to 1839.

Months.	South of the Observatory.—Unshaded.						North of the Observatory.—Shaded.						
		Depths.						Depths.					
	Surface, Noon. 4 years.	0·15 Mètre (0·49 foot). 2 years.	0·40 Mètre (1·31 foot). 1·25 year.	0·60 Mètre (1·96 foot). 4 years.	0·80 Mètre (2·62 feet). 4 years.	1 Mètre (3·28 feet). 2 years.	Surface. 6 years.	0·19 Mètre (0·58 foot). 6 years.	0·45 Mètre (1·47 foot). 6 years.	0·75 Mètre (2·46 feet). 6 years.	1 Mètre (3·28 feet). 5 years.	3·9 Mètres (12·8 feet). 5 years.	7·8 Mètres (25·6 feet). 5 years.
Jan.	36·7°	34·°	34·2°	37·1°	38·2°	38·5°	37·°	38·9°	40·6°	42·1°	44·3°	53·4°	54·5°
Feb.	39·	34·6	34·3	36·8	37·8	39·	38·7	38·7	39·8	41·	43·7	51·6	54·
March	45·5	39·3	40·2	39·7	39·9	40·6	41·5	40·9	41·5	42·2	44·	50·2	53·4
April	51·3	42·6	43·9	43·1	42·9	42·8	44·6	43·1	43·3	43·6	45·	49·6	52·8
May	65·7	53·4	54·6	51·3	50·2	49·5	53·5	50·4	50·	49·3	49·5	49·8	52·2

Place of observation.	Extremes.	Means.	Ranges.
Surface	43°· —73°·4	59°·1	30°·4
Three feet deep..	71·1—73·7	72·1	2·6
Six „ „ ..	70·6—71·6	71·2	1·
Nine „ „ ..	71· —71·8	71·2	0·8

Depth.	Southern aspect.—Unshaded.				Northern aspect.—Shaded.			
	Lowest.	Spring mean.	Highest.	Autumnal mean.	Lowest.	Spring mean.	Highest.	Autumnal mean.
Surface	Jan. 13	Apr. 25	July 9	Oct. 20	Jan. 17	May 3	July 18	Oct. 21
Mètres. Feet.								
0·15 .. 0·49..	„ 14[a]	May 2	„ 9[a]	„ 30				
0·19 .. 0·58..	..	..	..	..	„ 29	„ 9	„ 24	„ 26
0·40 .. 1·31..	Feb. 8[b]	..	Aug. 2[b]					
0·45 .. 1·47..	..	..	..	..	Feb. 5	„ 13	„ 30	Nov. 4
0·60 .. 1·96..	Jan. 30	„ 9	July 23	Nov. 2				
0·75 .. 2·46..	..	..	..	..	„ 17	„ 18	Aug. 6	„ 8
0·80 .. 2·62..	„ 30	„ 12	„ 25	„ 8				
1· .. 3·28..	„ 25[a]	„ 19[a]	Aug. 6	„ 4[a]	„ 27	„ 24	„ 9	„ 13
3·9 .. 12·8..	..	..	..	..	Apr. 20	July 17	Oct. 14	Jan. 10

Between the times at which the lowest, highest, and mean, temperatures, respectively, occur at the surface and at different depths, the hereafter mentioned periods, therefore, intervene :—

Surface							
Mètres. Feet.							
0·15 .. 0·49..	1 day[a]	7 days	..	10 days[a]			
0·19 .. 0·58..	..	..	..	..	12 days	6 days	6 days	5 days
0·40 .. 1·31..	25 days[b]	..	24 days[b]					
0·45 .. 1·47..	..	..	..	..	7 „	4 „	6 „	9 „
0·60 .. 1·96..	..	..	..	3 „				
0·75 .. 2·46..	..	..	..	..	12 „	5 „	6 „	4 „
0·80 .. 2·62..	..	10 „						
1· .. 3·28..	..	7 „[a]	4 „	2 „[a]	10 „	6 „	3 „	5 „
3·9 .. 12·8..	..	..	..	..	52 ..	53 „	66 „	58 „

Quetelet, *Memoires de l'Académie Royale de Bruxelles*, x. pp. 3—80, xiii. pp. 3—52. (Abridged.)

[a] One year only. [b] Two years only.

From the 22nd of May to the 13th of July, however, the extremes, means, and ranges were;—

At Greenwich observations have been made daily, for many years, on thermometers—at the surface and at depths of 1 inch, 3·2, 6·4, 12·8, and 25·6 English (3·, 6·, 12·, and 24· French) feet. "The soil [is composed] of beds of sand; of flint-gravel with a large proportion of sand; and of flints with a small proportion of sand, cemented almost to the consistency of pudding-stone. * * * [Those parts of the tubes which project above the surface] are protected by a wooden case or box fixed to the ground; the sides of the box are perforated with numerous holes, and it has a double roof. In the North face of this box is a large plate of glass through which the thermometers are read." The extremes and means observed during the years 1865, 1866, and 1867 have been;—

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
					At the surface.							
	°	°	°	°	°	°	°	°	°	°	°	°
Highest	53·6	55·2	57·8	75·8	81·6	83·9	84·5	84·7	82·7	73·2	63·	54·3
Lowest	20·	30·3	33·1	44·	42·3	54·6	57·	56·1	50·9	45·	37·9	28·7
Mean	40·5	44·1	43·	57·8	61·9	69·1	69·8	68·2	67·	57·5	47·7	43·1
					At a depth of one inch.							
Highest	50·2	50·7	50·1	59·4	65·	69·5	77·1	70·6	70·5	63·2	56·8	51·9
Lowest	29·	31·2	35·1	43·8	45·2	57·5	56·8	55·7	52·1	46·6	39·	34·3
Mean	40·2	42·7	40·7	51·2	55·5	63·	64·6	62·8	61·7	54·2	46·6	43·3

Place of observation.	Extremes.	Means.	Ranges.
Surface	43°· —73°·4	60°·1	30°·4
Three feet deep..	71·1—73·7	71·9	2·6
Nine „ „ ..	70·7—71·8	71:1	1·1

The intervals between the times of highest and of lowest temperatures at the surface and at different depths, are shown in the foregoing columns.

The highest, lowest, and mean temperatures, as well as the ranges at the surface and at various depths, were—

	Highest.	Lowest.	Means.	Ranges.
Surface	84°·7	20°·	55°·8	64°·7
1 inch in depth .	77·1	29·	52·2	48·1
3·2 feet „ ..	64·4	39·1	51·6	25·3
6·4 „ „ ..	61·4	44·2	52·4	17·2
12·8 „ „ ..	57·2	44·8	51·4	12·4
25·6 „ „ ..	52·9	48·	50·9	4·9

Magnetical and Meteorological Observations at the Royal Observatory, Greenwich, 1865, pp. XLII.—III., CCLXXXIII.—VII.; 1866, pp. XLIII.—IV., CXCII.—VI.; 1867, pp. XLIV.—V., CCLXIII.—VII.

At and near Edinburgh observations were continued from 1837 to 1842 at depths of 3·2, 6·4, 12·8, and 25·6 (English) feet;—

on the Calton Hill, ... in porphyritic trap, at 350 feet above the sea;
in the Experimental Garden, „ sand , „ 70 „ „ ;
& at Craigleith, „ sandstone , „ 150 „ „ ;
with the undermentioned results;—

Depth.	Calton Hill.				Experimental Garden.				Craigleith.			
	Highest.	Lowest.	Means.	Ranges.	Highest.	Lowest.	Means.	Ranges.	Highest.	Lowest.	Means.	Ranges.
3·2 feet	56°·2	35°·7	45°·5	20°·5	57°·2	35°·1	46°·1	22°·1	55°·9	35°·4	45°·9	20°·5
6·4 „	52·3	39·7	45·8	12·6	54·6	38·6	46·4	16·	53·8	38·1	45·9	15·7
12·8 „	49·4	43·6	46·3	5·8	50·6	42·8	46·7	7·8	51·1	40·7	45·9	10·4
25·6 „	47·8	46·	46·8	1·8	48·2	46·	47·1	2·	48·5	43·8	46·	4·7

The mean temperature of the air, at surface..... was 45°·2
„ on an average of all the stations, at 3·2 feet deep „ 45·8
„ „ 6·4 „ „ 46·
„ „ 12·8 „ „ 46·3
„ „ 25·6 „ „ 46·7

FORBES, *Edin. Phil. Trans.*, XVI. pp. 194, 204,—7; *Proceedings of the Royal Society of Edinburgh*, I. pp. 223, 344*.

The depths at which the observations were made;—the mean temperature of each spot at the commencement of the series (on the 22nd of May, 1849);—and the nearest periods at which these were, respectively, the means of the climate; are shown in the following columns:—

Depth.	1849, 22nd May. Mean temperature, underground.	Nearest preceding day on which the mean of the climate approached most closely to the temperature underground.		Interval, days.
		Date.	Mean temp., surface.	
Three feet ..	73°·3	Mar. 3	74°·3	80·
Six „ *..	71·4*	Apr. 6	72·7	46·
Nine „ ..	71·6	Apr. 6	72·7	46·

At Upsal thermometers sunk 1·07 foot, 2·14 and 3·20 feet in the ground, and observed daily at six in the morning, two in the afternoon, and nine at night, showed temperatures of which the monthly means are set forth in the following columns:—

The proportion of solar heat absorbed by the ground must, of course, depend, in some measure, on the nature of the surface.*

The following columns set forth the means of observations, at the surface, as well as at depths of three,

---

"The observations from which the following table has been deduced were made at Alverton, near Truro, in 1852—3. * * * Four pits, about two feet deep and two feet wide, were dug in good healthy garden loam. [The first] was filled with yellow clay frem the clay-slate; [the second] with pure white sand, from the sand-bed at St. Agnes Beacon; [the third] with peat, almost pure vegetable matter, well worked before put into the pit; [the fourth] with garden loam. The bulb of the thermometers was placed 4 inches below the surface in the centre of each pit, and another thermometer was placed in the same manner under the short grass of the lawn. Each variety of soil was thus subject to the same drainage below and to the same influences above. The readings of the thermometers were made in the morning when the temperature of the soil was lowest, and again in the evening when it was highest * * * .

"Temperature of the air and of different kinds of soil, Alverton, near Truro.

Date.	Air. Mean temp.	Clay. Mean temp.	Siliceous Sand. Mean temp.	Peat. Mean temp.	Garden Loam. Mean temp.	Grass. Mean temp.
1852. Sept.	57°·7	56°·6	60°	57°·6	59°·6	60°·1
Oct.	51·1	50·1	50·	51·6	51·1	54·2
Nov.	50·9	46·1	49·1	50·2	50·2	52·2
Dec.	49·3	46·7	46·2	47·8	48·1	49·6
1853. Jan.	44·9	42·1	42·1	43·7	43·2	46·7
Feb.	37·	36·	34·6	37·4	36·8	40·8
March	44·4	41·1	40·4	42·2	41·3	45·2
April	50·5	49·9	50·	50·8	50·8	53·
May	53·4[a]	57·1	57·2	57·7	58·3	60·1
June	57·6	64·	63·9	63·5	65·1	67·3
July	60·5	63·1	63·	63·8	64·3	67·2
Aug.	60·5	62·	62·5	62·8	63·9	68·1
Annual Means ..	51·5	51·2	51·6	52·4	52·7	55·4

WHITLEY, *Bath and West of England Agricultural Journal*, III. pp. 12—15. (Abridged.)

[a] 1852.

six, and nine feet; at 6 A.M., noon, and 6 P.M., during the same period;*—

Place of observation.	6 A.M. May.	6 A.M. June.	6 A.M. July.	6 A.M. Means.	Noon. May.	Noon. June.	Noon. July.	Noon. Means.	6 P.M. May.	6 P.M. June.	6 P.M. July.	6 P.M. Means.	General means.
Surface	57°·8	56°·8	51°·9	55°·5	56°·5	60°·3	64°·7	62°·5	63°	63°·2	61°·5	62°·6	60°·2
3 feet deep..	72·7	72·7	71·5	72·3	72·7	71·9	71·4	72·0	72·6	71·8	71·4	72·	72·1
6 „ „ ..	71·2	71·2	—	71·2	71·2	71·1	—	71·2	71·2	71·	—	71·1	71·2
9 „ „ ..	71·3	71·4	70·8	71·2	71·4	71·2	70·8	71·1	71·4	71·1	70·7	71·1	71·1
Means, at 3, 6, and 9 feet deep	71·7	71·7	71·1	71·5	71·7	71·4	71·1	71·4	71·7	71·3	71·	71·4	71·5

It would seem, therefore, that at depths of three, six, and nine feet respectively, the mean temperatures slowly declined, both from May to July, and from morning to evening.† These observations, however, extend to neither of the annual extremes.

W. J. HENWOOD.

3, CLARENCE PLACE, PENZANCE.
1870, March 30th.

---

* Such observations only as were made simultaneously at the several stations, have been used in deducing these averages.

† At Trevandrum observations—at intervals of six hours—from the 1st of May 1842 to the 31st of December 1845, afforded the undermentioned results.

Depths.	Hours of observation. 6 A.M.	Noon.	6 P.M.	Midnight.	Means.
3 feet	82°·50	82°·66	82°·55	82°·50	82°·55
6 „	83·79	83·98	83·88	83·82	83·87
12 „	83·90	83·99	83·95	83·90	83·93
Means	83·46	83·54	83·46	83·41	83·45

CALDECOTT, *Bulletins de l'Académie Royale de Bruxelles*, IX. Partie I. pp. 303—10; *Proceedings of the Royal Society of Edinburgh*, I. pp. 432—3; *Edinburgh Phil. Trans.*, XVI. p. 391. (Abridged.)

EXPLANATION OF THE PLATES.

Copies of Working-plans and Sections of mines are marked with asterisks (*).

In the Plans *lodes* are represented by single, and *cross-veins* by double, lines.

In Longitudinal Sections the darkest shades indicate the portions which have been removed.

CHILI.

Plate I.

Plan of the Mining District of Chañarcillo.

Plate II.

Longitudinal section of the *Colorada lode*, Chañarcillo.†

BRAZIL.

Plate III.

Bird's-eye view of the gold-formation at different depths in *Morro Velho*.*

Plate IV.

Fig. 1*. Plan of *Gongo Soco.*
„ 2*. Longitudinal section of the *Gongo* gold-formation.
„ 3*. „ „ *Cumba* „ .
„ 4. Transverse section of the strata.‡

CORNWALL.

Plate V.

Fig. 1*. Plan of *West Caradon.*
„ 2*. „ *South Caradon.*
„ 3*. „ *Wheal Trelawny.*
„ 4*. „ *Wheal Mary Ann.*

---

† Drawn from survey by Edwin Price Waring, Esq., Superintendent of *Colorada.*
‡ „ „ Captain John Luke of *Gongo Soco.*

Plate VI.

Projections of temperatures observed, at the surface and at depths of three, six, and nine feet, within the tropics.

WOODCUTS.

NORTH-WESTERN INDIA.

Fig. 1. The *Danda* mine; Section. Beds of metalliferous quartz; in talcose and chloritic slates.

„ 2. „ *Dhunpoore* „ ; „ . Jointed structure common to limestone and slate.s

„ 3. „ „ „ ; View of the joints, and of the *(bunches)* masses of copper-ore which occur at their intersection.

„ 4. „ „ „ ; Plan „ „ „ .

„ 5. District of Agur; „ beds of iron-ore, in quartzose-talc, and in clay-slates.

CHILI.

„ 6. „ Chañarcillo; Plan. Jointed structure of the first limestone.

„ 7. „ „ ; Transverse Section. *Colorada, Waring, Descubridora,* and *Candelaria lodes; Manto de Ossa*: first limestone.

Clay-slate.

Fig. 14. *Gongo Soco (Camara)*; Plan (Sketch). Isolated *(bunches)* masses of auriferous quartz, in variously coloured clay-slates.

„ 15. *Morro Velho*; Transverse Section (Sketch). Formation of auriferous iron-pyrites and quartz, in clay-slate.

Jacotinga.

„ 16. *Pitangui*; Transverse Section (Sketch). Bands of auriferous *Jacotinga.*

„ 17. *Agoa Quente*; Transverse Section (Sketch). Alternating bands of iron-ore and quartz *(Itabirite)*, displaced *(heaved)* by minute veins of quartz.

„ 18. „ ; Horizontal Section (Sketch). Schistose rocks of iron-glance and quartz *(Itabirite)* interfoliated with auriferous *Jacotinga.*

„ 19. *Catta Preta*; Transverse Section. Isolated masses of auriferous quartz imbedded in iron-glance, manganese, and talc.

„ 20. *Cocaës (Alto da Cruz)*; Longitudinal Section. Layers of talc in iron-glance and quartz.

„ 21. *Gongo Soco*; Horizontal Section. A conformable layer of rich auriferous *Jacotinga* interlying a *(horse)* mass of iron-glance and quartz *(Itabirite)*, surrounded by *Jacotinga* thinly sprinkled with particles of gold.

„ 22. „ . View of flexures in schistose iron-glance interfoliated with quartz *(Itabirite).*

„ 23. „ ; Transverse Section. Contorted layers of talc and auriferous *Jacotinga.*

„ 25. „ ; Longitudinal Section. Alternating layers of iron-glance and slightly auriferous *Jacotinga* displaced *(thrown)* by thin *cross-veins* of quartz.

UNITED STATES.

„ 26. *North American Mine.* Massive and cellular quartz sprinkled with native copper.

Fig. 27. *South Cliff Mine.* Minute grains of native copper and trap in a vein of prehnite traversing trap-rock.

„ 28. *Douglas Houghton (Henwood) Mine.* Longitudinal Section of the Works.

„ 29. „ „ . Grooved surface of vein-stone and native copper.

CHANNEL ISLANDS.

„ 30. *Sark's Hope Mine.* Longitudinal Section of the works.

IRELAND.

„ 31. *Knockmahon Mine; Stage lode.* Longitudinal Section of the works.

CORNWALL.

„ 32. *Wheal Trelawny.* Section of a concretion imbedded in clay-slate.

INDEX.

Abraham, Wheal, ventilation obtained by a fall of water at, 220.
Academies, Mining, at Chemnitz and Freiberg, 691.
Adams, Wheal, and *Exmouth*, proportions of silver in ore and lead of, 110.
Adit, system of drainage by, in the Himalaya, 50.
——, at *Wheal Agar*, copper precipitated from water of, 585.
——, in Gwennap, the extent of, 585.
——, ————, commencement of, 586.
——, ————, quantity of water flowing through, 586.
——, ————, temperature of „ , 586.
——, ————, analysis of „ , 586,—8.
——, ————, precipitation of copper from } „ , 586—8.
——, at *Tresavean*, „ water of, 588.
——, at *Dolcoath*, slight precipitate of copper from water of, 589.
Agar, Wheal, precipitation of copper at, 585,—92.
Agnes, Saint, profits afforded by mines in the district of, 453—4.
————, subterranean temperature „ , 752.
Agoa Quente, mine of, 224—36.
————, rocks of, 224—7, 729.
————, auriferous deposits of, 227—36, 319,—23,—29,—31.
————, ————————, proportions of gold contained in, } 230–5, 326.
————, ————————, ————————, at different depths, 331.
————, ————————, quantities of gold obtained at, 235, 367.
————, ————————, quality „ , 236.

Agoa Quente, subterranean temperature at, 729—31,—56.
————, climate of, 729; Table XXXI.
————, rain at, 730.
————, temperatures at depths of three, six, and nine, feet, at, 768—80; Table XXXVII.
————, growth of fish in warm water at, 355, 731.
Agordo, treatment of inferior copper-ores at, 579.
Agua, Manto de, a calcareous bed impervious to water, at Chañarcillo, 77.
Agur, the rocks, iron-ores, and smelting-works of, 21—2, 57.
Agur, Al, the rocks and copper-ores of, 11.
Air, issue of from joints in the *Itabirite*, at *Gongo Soco*, 250.
—, ———————— chalk at Belvedere, 250.
Airy, G. B., Esq., subsidence of rocks, and veins at *Dolcoath*, 666.
Akysá, sandstones and iron-ores of, 67.
Alabama, auriferous rocks of, 371.
Alderley Edge, ores of copper in sandstone at, 77.
Ale and Cakes, early use of *plunger-pole* at, 570.
Alfred, Wheal, silver ores obtained at, 112.
————, ancient mode of operation, long continued at, 146.
————, profits realized at, 445; Table XIV.

Alloy, nature and proportion of in New Granadian gold, 360.
——, ——————————— Siberian gold, 335,—60.
——, ——————————— Virginian gold, 374,—77,—82.
——, ——————————— Welsh gold, 642.
Almora, composition and structure of granite near, 2.
———, frequency of earthquake-shocks at, 49.
Altitudes, temperatures of mines at various, 758; Tables XXXII., XXXV., XXXVI.
Aluknunda, auriferous sands of the, 3, 46—7.
Amalgamation, 97, 377; Tables VII., XXII.
America, North, auriferous rocks of, 371.
———, South, „ , 168—370.
Amygdaloidal rocks, south of Lake Superior, 398, 422,—38.
Analyses, of mineral-waters, 573,—86—8,—90—3.
———, „ rocks, 75,—8, 80, 240,—67, 399, 613.
——— and assays of different metals and ores, 95,-121,-43,-67, 197-8, 204-6,-37,-86, 334-5,-8,-58.-73,-4,-8,-83, 472-3, 522 523,-36,-45-8,-50,-66,-8,-71,-81-92, 630,-2,-42, 708-9,-11; Tables VII., XXII.
Andrada, Senr. Gomes Freire de, his attempts to preserve the forests of Brazil, 343.
Angles, included between *lodes* and *cross-veins*, 127-9, 225, 527,— 558-60,-98, 608,-22,-83-85, 717; Table III.
———, ——————————— strata, 406.
Ann, Wheal, silver and silver-ore of, 112.
Anna, Santa, auriferous deposit of, 214.
Ansermo Nuevo, temperature of, 770.
Ansted, Professor, on the auriferous series of Virginia, 379—81.
———————, ——— detrital gold of „ , 384.
———————, ——— proportion of gold extracted at the *Buckingham* mines, 377—9.
———————, ——— geology of *Cobre*, 441.
———————, ——————— Sark, 530—2.
———————, ——————— Herm, 736.
———————, ——— climate of Guernsey, 735.

Ansted, Professor, on the wells of Herm, 737.
Antimony, ores of, 118–19,–21,–79, 334,–74, 526,–35–6,–45,–8, 566, 617, 707.
Antiquities, discovered in copper-mines near Lake Superior, 415–19.
————, imbedded in detrital matter, 344—5.
Antonia Pereira, disappearance of rivulet beneath rubbish, in the dry season, 353.
————, ores, metals, mines, and smelting-works at, 213, 303,—59.
————, rocks of, 303.
———— rubbish from mines carried into river Gualaxo during the rains, 303.
Ants, damages done by, 350—1.
——, discovery of gold in a nest of, 243.
Apire (labourer), the weight of ore extracted by, in Chili, 147.
Apjohn, Professor, analyses of lead, zinc, iron, and auriferous ores by, 545—50.
Aplin, P. H., Esq., proportion of tin-ore in the vein-stone of the *Saint Ives Consolidated Mines*, 472.
Arabia, sounds emitted by moving sand in, 154.
Archiac, Viscount D', on the temperature of coal-mines in Virginia,

Austell, Saint, valley near, cumbered with rubbish from China-clay works, 353.
——————— district, subterranean temperature in the, 752.
Australia, auriferous granite of, 175.
———, ——— beds of quartz in, 179; Table XXII.
———, ——— detritus of, 343.
———, crystals of gold in „ , 356.
———, proportion of silver in the lead-ore of, 99.
Awdeef, M., on relations between the crystalline forms, and the qualities of gold, 336.
Azevedo, Captain John Pereira de, on the gradual filling of the river Gualaxo, by rubbish washed from the mines of *Antonio Pereira*, 353.

Baddern, Wheal, proportions of silver in the lead-ores of, 120.
Badrinath, offerings by pilgrims to the shrines of, 29.
Bags of uncured hides, used for extracting ores from mines, 49, 147.
——————————, —— as bellows, 54.
Bailey, Professor, on the rocks and metalliferous deposits of New Brunswick, 490-2,-6-7,-9, 507.
Baily, W. Hellier, Esq., on the fossiliferous rocks of Knockmahon, 595.
——————————, ——— organic remains at Brownstown, 623.
Baird, Mr. William, on iron-smelting in Brazil, 261.
Baize, its use in washing *(dressing)* gold, 203, Table VII.
Bal-dhu, silver sprinkled through the *gossan* at, 114.
Baldwin, Mr. Sheriff, his discovery of gold in New Brunswick, 498.
Balleswidden, proportion of tin-ore in the vein-stone of, 472.
——————, dimensions of holes, weight of powder used, and amount of stone broken in blasting at, 200.
——————, underground works lighted with gas 669.
Ballygahan, the beds of iron-pyrites and copper-pyrites at, 548-53.
————, displacements *(heaves)* of the metalliferous deposit *(Sulphur-course)* by joints at, 559.
Ballymurtagh, the beds of iron-pyrites at, 548,-53-5.
——————, gold disseminated through some of the iron-ores at, 549-50.

Ballymurtagh, precipitation of copper from mine-water at, 573–88.
Bamboo, growth of in water occasionally frozen, 45.
Banat, proportion of silver in auriferous iron-pyrites, of the, 100.
Banka (Banca), the rocks, tin-ore, and gold of, 631.
Bankart, Frederick, Esq., on the copper-ores of, *Eardiston*, 515.
——————————, —— precipitation of copper at *Lucençia*, 590.
Bankart, Howard, Esq., on the quality of precipitate from water of the Gwennap *adit*, 587.
Baranquilla, on recent sandstone at, 155.
Barley, cost of at Chañarcillo, Table V.
Barnett, Capt., R.N., on Magnetic declination in Jamaica, 511.
Baroolee, the iron-ores of, 33.
Barrel-work, proportion and quality of, in the mines near Lake Superior, 434.
Barreteros (miners), wages of, in Chili, 151; Table V.
Barrow, comparative cost of work by it, and by tram-way, underground, 144.
Barrul Cajoor, iron-ores and sandstones of, 67.
Barytes, the sulphate of, its modes of occurrence, 513,–46, 707.
Basset, family of, their *heir-looms* of plate manufactured from the silver of *Dolcoath*, 113.

Batten, J. Hallet, Esq., on the iron-mines and miners of Dhunneea Kote, 34.
——————, ——————— Munglalekh, 26.
——————, on the ravages of wild beasts in the Himalaya, 17.
——————, ——— revenue from mines „ 63.
Bauerman, Hilary, Esq., on the *drift* of Lake Superior, 485.
——————, ——— native copper of „ , 483.
——————, ——— produce of copper „ , 489.
Bayfield, Capt., R.N., on the conglomerates of Lake Superior, 403.
——————, ——— sandstones of „ , 392.
——————, ——— magnetic declination in New Brunswick, 492.
Beans, prices of, in Chañarcillo, Table V.
Bearhaven mines, cross-course of, 608.
——————, *lodes* of the, 603—8, 741; Table XX.
——————, ——————, one of the, inclines at a higher angle than the cleavage-planes of the rocks, 564, 604.
——————, rocks of the, 602—3, 740.
——————, the workmen of sometimes cook their food underground, 610.
——————, water, quantities of, at different seasons, 609.
——————, a steam-engine and forges underground, 610.
——————, subterranean temperature, 742.
Beaumont, de, M. L. Elie, on the structure of gneiss, 519.
Beche, Sir H. T. De la, on the rocks intersected by the Agua Alta, 511.
——————, ——— elevation of the Caradon district, 696.
——————, ——— granite of Brownwilly, 662.
——————, ——— hornblendic rocks of Saint Cleer and Menheniot, 672.
——————, ——— joints in the granitic and schistose rocks of Cornwall, 673.
——————, ——— rocks N. of Hessenford, 701.
——————, ——— serpentine of the Lizard District, 646.
——————, ——— silver-ore of *Herland*, 111.
——————, ——— the alleged waste of copper near Tavistock, 693.
Beckett, Mr. Deputy Collector, on iron-smelting in the Himalaya, 57.

Beds, of pebbles and gravel in the Himalaya, 45.
——, „ shingle, gravel, and sand in Chañarcillo, 142.
——, „ shingle, gravel, sand, and shells near Caldera and Copiapò, 139,—57.
——, metalliferous, 4, 5, 7–16, 18–33,–5–41, 67, 82, 161,–79–83, 87–207,–14–16,–19–32, 237–41,–2–6,–8–86, 298–304,–11–40,–72,–5,–7,–80, 496, 509, 513,–43–69,–74–8, 616,–20,–3, 726,–8,–9, 732,–3,–8,–44.
Beef, price of at Chañarcillo, Table V.
Beeralston, proportions of silver in the lead-ores of, 109–10.
Bejapoore, the ferruginous conglomerate of, 39.
Bella Fama, on the employment of fire-flies to light the miners at 209.
Belden, Dr. J. H., on the use of fire-flies to give light to miners at their work in Brazil, 209.
Bellar, the copper-ores of, 4.
Belt, Thomas, Esq., on the proportions of gold at various depths in the quartz formations of Australia, 179.
Belvedere, issue of air from joints in the chalk at, 250.
Bengal, on certain iron-ores and sandstones in, 64—8.
Bento Rodriguez, on the *(Cascalho)* detritus of, 343.
Beresite-rock, description of, 177.
Berezovsk, on the auriferous deposits of, 177.

Blamey, Capt. Thomas, on the auriferous deposit of *Agoa Quente*, 233.
———————, ——————————— *Gongo Soco*, 250,-4,-7,-60,-8,-6,-8,-9,-72,-4.
———————, on the manufacture of iron in Brazil, 262.
———————, ——— deflection of a *lode* at *Chalanches*, 520.
———————, ——— precipitation of copper at *Tresavean*, 589.
———————, ——— assistance afforded to the writer by, Table VIII.
Blamey, John, Esq., notice of diamonds discovered at the Corrego de São Miguel, 242.
Blas San, produce of, 124; Tables IV. XIV.
Blast, means of obtaining, 54, 219-20, 528.
Blasting, extent of at *Morro Velho*, Table VII.
———, dexterity of the Cornish miner in, 151-2.
———, quantities of gunpowder used under various circumstances in, 201.
———, ——— of ore extracted by, at *Morro Velho*, Table VII.
———, ———————————, in other mines, 200.
———, ———————————, at different depths in *Morro Velho*, 199-200.
Blavier, M., on the argentiferous lead-ores of Aveyron, 104.
Blende, occurrence of, 86, 112, 545-6, 621,-40, 707.
Blight, Mr. J. T., on the occurrence of stream tin-ore in the Caradon district, 695.
Boase, Dr. H. S., on concretionary structure, 702.
———————, „ the directions of valleys, 718.
———————, „ relations between the structure of rocks and *lodes*, 187.
———————, „ curvatures in beds of schistose rocks, 259.
———————, „ granite of Caradon, 662,-72.
———————, „ hornblendic rocks of Saint Cleer and Menheniot, 662,-72, 702.
———————, „ junctions of granite and slate in Cornwall, 667.
Boa Vista (near Ouro Preto), on the topaz formation of, 308.
Bocona, extent and produce of works at, 124; Tables IV. XIV.
Bohemia, proportion of silver in lead-ore of, 101.
Boiling Well, proportions of silver in lead-ores of, 120.
Bolaco lode, extent and produce of works on, 124; Tables IV. XIV.
Bolivia, quality of detrital gold in, 360.

Bond, Thomas, Esq., scenery of the Caradon district, 697.
Bonina, Padre, water-wheels first erected by, in the gold-districts of Brazil, 361.
Bonnard, M., on the proportion of silver in the lead-ore of Bohemia, 101.
Bonegarh, on the iron-ore of, Table II.
Borer, the, differently used in different districts, 151–2.
Borgnet, Professor, on the influence of forests on the sources of the Meuse, 138.
Borlase, Dr. William, on the native-silver of Saint Just, 110.
——————, —— argentiferous lead-ores of Cornwall, 118,–19.
——————, —— tin-mines of *Polberrou* and *Polgooth*, 453,–4.
——————, —— detrital tin-ore of Cornwall, 486.
——————, on early copper-mining in Cornwall, 687–8, 691,–2.
——————, on the Wringcheese & Kell-mar'r rocks, 696.
Borriga, on the copper-ores and sandstones of, 514.
Borringdon Consolidated Mines, proportion of silver in the lead-ore of, 110.
Borrow, Henry, Esq., on profits obtained at *Levant*, 442; Table XIV.
Boscean, proportion of metal in the tin-ore of, 472.
Botallack, extent of submarine works at, 599.

Brazil *(Minas Geraës)*, elevation of mountains in, 169.
———————, the forests of, 170, 296.
———————, ————, destruction of, occasioned a scarcity of water, 344.
———————, ————, laws for the preservation of, 296, 343–4.
———————, ————, manufacture of charcoal in, 219, 226–32.
———————, pastures of, 168–9, 296.
———————, rocks of, 171–3,–6–8,–80,–6, 209–12,–16, 221,–42–4,–7–50,–97–307.
———————, discovery of gold in, 360.
———————, gold-mines of, 175,–7–84,–7–207,–9–16, 221–41,–5–7,–9–88,–98–304.
———————, ————, people employed by British Mining Companies in the, Tables VII. IX.
———————, detrital gold of, 342–59.
———————, proportions of gold obtained from different formations, 369.
———————, alloys of gold „ „ , 206, 286, 333–40.
———————, iron smelting-works of, 219,–42,–7,–61.
———————, mining laws of, 361–5.
———————, water-wheels first used in the mines of, 361.
———————, machinery of British manufacture now in use at the mines of, 288.
———————, British capital invested in the mines of, 246,–89, Tables IX. XIV.
———————, returns and profits made by British Mining Companies in, 208,–89; Tables VII. IX. XIV.
———————, quantities of gold obtained in, 366–9.
———————, duties paid by miners to the government in, 208,–89, 361–7; Tables VII. IX. XIV.
———————, supercession of mining by agriculture in, 370.
———————, Slavery at *Gongo Soco*, 289–96.
———————, Slaves of native masters, permitted to search for gold on their own account during holidays, 301.
———————, ———, children of, educated at *Gongo Soco*, 295.

Brazil *(Minas Geraës)*, climate of, 349, 725–9; Tables XXX. XXXI.
——————, subterranean temperature in, 725–32.
——————, temperatures at the surface and at depths of three, six, and nine feet compared, 767–780; Table XXXVII.
——————, Magnetic declination in, 177.
Bread, cost of in Chañarcillo, Table V.
Breadalbane, the Marquis of, his discovery of the chromate of iron, 647–9.
——————, ——————— the sulphuret of molybdènum, 654.
Breage, directions of the *lodes* and valleys in, 718.
Brecciated structure, in rocks, 30, 65, 712.
——————, „ *lodes*, 84, 463, 712.
Britany, disposition of the ores of silver and lead in the *lodes* of, 537.
Bromide of silver, the mode of its occurrence in Chañarcillo, 90,–2, 100.
Brongniart, M. Alex., on the diminished produce of the deeper parts of the *lodes* at *Chalanches*, 526.
Brothers, *Wheal*, proportions of silver in the ores of, 115.
Brown, Capt. J. T., on the cost of dividing large masses of native-copper, 428.

Bunches, rich, strata in the vicinity of, occasionally metalliferous, 274, 326, 476.
——————, often occur on confronting portions of neighbouring deposits ..... } 123, 264, 326, 330, 476.
——————, ——————————————, but not always, 608.
——————, disposition of metals and ores in, 89, 271,-3,-4-80, 326, 431-4, 640.
——————, endlong dip *(shoot)* of, 122-5, 206-7,-24,-9,-32,-5, 263, 537,-89,-98.
——————, occur in the most highly-inclined portions of deposits, 82, 189, 270, 311, 604.
——————, proportions of metallic minerals in, 98, 120, 274-81, 435-6,-70-1,-82,-98.
——————, of the precious metals smaller than the *bunches* of less valuable ores, 122.
Bunna, iron-ores of, 20.
Bunnà, „ , 22; Table I.
Burgoyne, F. M. Sir J. F., on the quantities of gunpowder required for blasting, 201.
Burnes, Sir Alex., on the noises emitted by moving sand, 154.
Burrulgaon, on the iron-ores and smelting-works of, 30, 57; Table II.
Burton, R. F., Esq., on subterranean temperature in Brazil, 726.
Busy, Wheal, proportion of tin-ore in the vein-stone of, 472.
Butler, Capt. T., copper first precipitated by, at Cranbaun, 585.

Cae Mawr, early discovery of gold at, 641.
Caëthe, on the granite of, 174.
——, deficiency of labourers in the neighbourhood of, 368.
Calcareous rocks, 31-7, 70,-1,-7-9, 87, 90, 161,-3,-72-3, 245,-9, 309,-13,-15,-24,-81, 411,-12,-20,-4,-31,-60, 466,-97, 517,-30,-1, 602,-11,-13,-15,-19, 620,-2,-3,-36.
——————, subterranean temperature in, 725.
——————, auriferous, 245,-9, 309,-13,-15,-24,-81, 638.
Calcareous spar, 31, 88, 91, 161,-3,-5, 245, 381, 403,-11,-20,-4, 431,-60,-3,-5,-8,-80,-522,-4,-33,-97, 606,-13, 619,-20,-4,-38,-40, 707,-14.
Caldcleugh, Alex., Esq., on the gold of Coquimbo, 167.
——————, „ „ Brazil, 182,—4.

Caldcleugh, Alex., Esq., on the iron-slate of Brazil, 171, 212.
——————————, „ quartz-rocks of Brazil, 171.
——————————, „ magnesian limestone of Brazil, 304.
——————————, „ topaz and euclase of Brazil, 305.
Caldecott, John, Esq., on the temperatures at various depths, and different times, at Trevandrum, 778,—80.
Caldera, elevated beds of recent shells near, 155.
———, ——————— contain the same *diatoms* as the present sea-beach, 160.
———, earthquake at, 157—8.
Callcott, Mrs. (Graham), on the elevation of the Pacific coasts by earthquakes, 159.
California, gold-deposits of, 339.
————, quantities and qualities of gold extracted in, Table XXII.
————, cost of extracting gold in, Table XXII.
Calstock, the silver-ores of 114—16.
Camara, Senr. Manoel Ferreira da, on the detrital gold of Brazil, 343.
Camara, gold formation of, 182, 327.
———, ——————, proportion of gold in, 247.
———, ——————, displacements *(heaves)* of, 183.
Camborne district, subterranean temperature in the, 752.
Canada, auriferous rocks of, 371.
———, detrital gold of, 384.

Caradon, the mining district of, 655—99.
———, „ granitic, slaty, *elvan*, and hornblendic rocks of, 655—664,-6-74.
———, „ stanniferous granite of, 664—6.
———, „ directions, dips, widths, and compositions of *lodes* in, 674—81.
———, „ tin, copper, and iron ores of, 676—80,—95.
———, „ directions, dips, widths, and compositions of the *cross-courses* in, 681—5.
———, „ intersections and *(heaves)* displacements of the *lodes* by the *cross-courses*, 683—5.
———, „ precipitation of copper in, 585, 686.
———, „ statistics of mining in, 457, 694—5,—8; Table XIV.
———, „ injury to meadows, by sand, mud, and foul water from the mines, 353.
———, „ subterranean temperature in, 744—6.
Carboniferous limestones, 611,—18,—20,—2.
——————— slates, 614, (?) 616.
Carclaze, area of the open-work at, 576, 665.
Carew, Richard, Esq., on resemblances between *lodes* and the rocks they traverse, 23.
——————————, „ partition of tin-ores amongst the partners in stream-works, 94.
——————————, „ early copper-mining in Cornwall, 686,-90, 692.
Cargoll, proportion of silver in the lead-ore of, 120.
Carn Brea mines, proportion of metal in the tin-ore of the, 472.
——————, produce and profits of the, 448,—59; Table XIV.
——————, winding-engines at the, 143.
Carne, Joseph, Esq., on the veins of Cornwall, 341.
——————, „ produce of parallel *lodes* on the same meridian, 258.
——————, „ native-silver and silver-ores of Cornwall, 110,—14,—16.
——————, „ argentiferous galena ..... „ , 118—20.
——————, „ economy of steam winding-engines } „ , 142.
——————, „ substitution of tram-ways for wheel-barrows in Cornwall, 144.

Carne, Joseph, Esq., on opening mines by means of *levels* and *winzes*, 146.
——————, on the submarine mines of West Cornwall, 600.
Carnon-Stream, on an issue of inflammable gas at, 453.
——————. „ the produce and profits of, 452—3; Table XIV.
Carnyorth, on proportion of tin-ore in the vein-stone of, 472.
Carter, Edwin, Esq., on the argentiferous lead-ore of *Trebiskengreen*, 120—1.
——————, „ proportions of tin-ores in the vein-stones of *Lanivet* and *Mulberry Hill*, 472.
Carriage, difficulties and expenses attendant on, in Brazil, 288.
Carvallo, mine of, extent and produce of works at, 124; Table XIV.
Carvoeira, formation of, at *Catta Preta*, 237.
Cascalho (detrital) gold-formations in Brazil, 342—5.
Cascajo, („) „ Chili, 345.
Catalan iron-furnaces, used in Brazil, 219.
Cattas Altas, ancient gold-mines near, 221.
——————, force employed and gold obtained in the vicinity of, 300.
——————, topaz in the neighbourhood of, 300.
Catta Branca, quartzose talc-slate of, 178.
——————, auriferous quartz of, 179.
——————, quantities and proportions of gold obtained from, 179, 327—67.

Chalanches, on the directions, dips, widths, and ingredients of the *lodes* at, 520—6; Table XVI.
————, „ nature of the ores obtained at, and proportions of silver extracted from them at, 103, 525–9.
————, „ direction, dip, width, composition, and influence of the *cross-vein* at, 526—7.
Chalk, on air issuing from crevices in the, 250.
Chañarcillo, elevation and scenery of, 69—70.
————, the rocks of, 70—80.
————, ————, metalliferous character of some of them, 76.
————, directions, dips, widths, and composition of the *lodes* in, 80—121; Table III.
————, *lodes* of, productive in the limestones only, 86.
————, ————, enriched on their union with *branches*, 91.
————, ————, nature of the ores they afford, and proportion of each kind, 89—93,—8—9.
————, ————, nature and value of ores obtained from them in the different limestone formations, 103–21, 536; Table IV.
————, ————, extraordinary richness of certain portions of, 91,—3.
————, directions, dips, widths, and compositions of *cross-veins* in, 124—6.
————, statistics of mining in, 149—53.
————, intersections and *(heaves* and *throws)* of rocks and *lodes* by *cross-veins* in, 126—35.
————, *cross-vein* intersected by a *lode* at, 129.
————, proportions of silver extracted from various ores by different modes of treatment, 97.
————, ores (when *dressed)* divided amongst the shareholders in mines at, 94.
————, ——, great quantities of, remaining both underground and at the surface, for want of water to *dress* them, 93—4, 148.
————, rude and wasteful modes of working the mines in, 145–147,—51—2.
————, cost of labour, food, water, and materials in, 150; Table V.
Chancellorsville (Grasty) mine, auriferous deposits of the, 372—5.
Chancourtois, M., proportion of silver in auriferous pyrites from the Banat, 100.

Charcoal, 56, 219,–62, 390.
———, different modes of preparing, 262, 390.
———, amount of afforded by given measures of wood, 390.
———, different qualities of, from wood grown on various soils, 219.
———, quantities of, used for smelting known weights of iron, 57, 390.
Charges of gunpowder used for blasting in different places, 200; Table VII.
Cheesewring, granite-quarries near the, 666,–72.
Chemnitz, the Mining Academy of, 691.
Chetoa Peepul, auriferous sands of the Aluknunda at, 4.
Chevalier, M. E., temperatures observed by, at different depths, in Brazil, 771.
Chifflones (winzes), vertical or highly-inclined openings on the courses of *lodes* in Chili, 147.
Children, gold extracted by, from sand and mud in the streets of Itabira, 217.
Chili, on the mines of silver and copper in, 69,—167.
——, ,, auriferous *(Cascajo)* detritus of, 345.
——, ,, mining laws of, 148.
——, statistics of mining in (Chañarcillo), 149–53.
China-clay works, damage done by refuse from, 353.
Chissels used for cutting rich masses of native metals, 91, 427–8.

Claussen, M. P., on the auriferous quartz of Brazil, 182.
——————, „ quality of gold from *Sta. Anna*, in Brazil, 215.
——————, „ proportions of gold from different formations, ... } „ , 369.
Clarke, Dr. E. D., on the application of fire to rocks and veins in Sweden, 51.
——————, „ use of torches of fire in the mines of Sweden, 52.
——————, „ accumulations of ice in the mines of Rôräas and Persberg, 479.
Clarke, The Rev. W. B., on the auriferous granite of Australia, 175.
Clay-ironstone of Bengal, 66—7.
Clay-slate, 21, 34, 172,-82,-4,-5,-94,-6, 210,-11, 494,-6-500, 541,-55,-63,-9,-74,-93, (?) 602,-70, 700.
————, alternating with talcose slate, 21.
————, alternately divided by, and dividing, auriferous quartz, 194; Table VI.
————, blended with a quartzose and pyritic matrix of gold, 194, Table VI.
————, alloys of gold in, 532,-4,-5,-7.
————, rate of blasting *lodes* in, 200.
————, subterranean temperature in, 726-7,-38,-40,-1,-6,-8, 749,-56,-8; Tables XXXIII. XXXV.
Cleavage, planes of, 9, 11, 20,-6,-8, 30,-1,-5, 163,-77-8,-80,-3, 186-7,-90,-3, 207,-11,-14,-16,-19,-21,-3, 227,-9,-37,-42,-5,-9,-51,-5,-7,-9,-64,-6, 269,-97,-8, 301,-3,-9,-11-14,-16-19,-72, 375,-7,-80, 500-1,-42-3,-51-5,-63,-8,-75, 593, 602,-4,-14,-37,-73, 703.
——————, in certain slates incline at higher angles than the *lodes*, 564, 604; Tables XVIII. XX.
——————, in deposits of iron-ores, 26,-8,-31,-5,-6, 187-188, 214,-15,-19,-21,-3,-7,-45,-9, 303,-13, 315,-17, 543,-51-3,-63.
——————, in auriferous deposits, 180, 211,-15,-19,-21,-3, 227,-59,-99, 301-2,-10-11,-13,-15,-17-18, 319, 372,-5,-7,-80, 549.-65-6; Table X.
——————, in cupriferous deposits, 8,-9,-11,-18, 548,-53, 556-7.
——————, enclosing *(Horses)* masses of rock, 20, 190, 251, 317,-78, 553-68, 606, 712.

Cliff mine, rocks of the, 422–3,–37.
———, relation between rocks and vein-stones at the, 437–8; Table XII.
———, direction, dip, width, and composition of the *lode* at, 423–39.
———, relations of copper to the structure of the vein-stones, 432.
———, proportion of (native) copper in the *lode* of, 434—6.
———, ,, fine copper in the crude metal of, at different depths, 436.
———, crystals of copper in, 431.
———, endlong dip *(shoot)* of copper in the *lode*, at, 438.
———, native copper sometimes encrusted with native silver, at, 436.
———, *slide*, and displacement of the *lode* by it, 439.
———, *man-engine* at, 439.
———, produce and profit at, 440,–59; Table XIV.
———, subterranean temperature at, 734.
Cliff mine, *South*, rocks of the, 460.
———, ———, relations between the rock and *lode* at, 460–2.
———, ———, masses of copper obtained at the, 462.
———, ———, proportions of crude metal contained in the vein-stones, 462.
———, ———, drift overlying the surface, 460.

Clogau, auriferous deposit of, 637–41.
———, produce and quality of gold obtained at, 641–2; Table XXII.
Clymo, Peter, Esq., on the produce and profits of *South Caradon*, 457; Table XIV.
Coal, the, of Bengal, 65,–6.
——, ————, drawn to Calcutta by locomotives worked with English coke, 68.
——, comparative cheapness of, as fuel at Lake Superior, 478.
——, the, of New Brunswick, 505.
———, ————, fossils in, 504–6.
———, ————, ——— ores of copper in, 509–10.
—— formations affording ores of copper in Nova Scotia and in Russia, 507–9.
—— wrought beneath the sea, 599–600.
—— mines, subterranean temperature in, 753–5.
Cobalt, ores of, 111,–12,–16,–21, 526,–46, 644.
———, ———, frequently associated with silver and its ores, 111, 112,–16,–21, 526.
Cobre (Cuba), rocks of, 441.
————, precipitation of copper at, 591–2.
————, produce and profits at, 441; Table XIV.
Cobre, el (Chili), early discovery of copper at, 154.
Cocaës, auriferous deposits of, 243–7.
———, ————, their discovery, 243.
———, quantity of gold obtained at, 247, 367.
Cock, W. J., Esq., analysis of gold from *Candonga*, 175, 334.
Cock, James, Esq., on the produce and profits of *Wheal Trelawny*, 719.
————, „ on the persons and steam-power at „ , 720.
Cock, Capt. Joseph, proportion of tin-ore in the vein-stone of *Poldice*, [472.
Cock, Wheal, on the native silver of, 110.
————, „ submarine works at, 600.
Coelho mine, gold of, associated with the ores of antimony, bismuth, and tellurium, 180.
Collacombe, West, proportion of silver in the lead-ore of, 110.
Collins, Capt. William, on the auriferous deposit of *Gongo Soco*, 250, 255,-7,-60,-3,-6,-8,-9,-71,-2,-4.
————, „ proportion of charcoal and smelting of iron-ore, 262.

Collins, Capt. William, on the auriferous *jacotinga* collected from the stream at Taboleiro, 252.
Colorada, the rocks of, 70—80.
———, the *lodes* of; their directions, dips, widths, compositions, and structures, 81–92; Table III.
———, ———; their characters in different rocks, 85—6; Table III.
———, ———, sometimes divide into veins on passing from one rock to another, 84.
———, ———, occasionally enclose *(horses)* masses resembling the adjoining rocks, 84.
———, ———, „ of cavernous structure, 77, 89.
———, ———, „ unite, 92.
———, ———, are enriched at their union with veins, 83, 91.
———, ———, richest when most highly inclined, 82.
———, ———, kinds, quantities, and qualities of the silver-ores they afford in the several limestones, 95–121; Table IV.
———, ———, exceptionally rich portions of, 90—3.
———, ———, deflected on the line of their dip by a bed of limestone which is rich in their vicinity, 82, 114—19.
———, one *lode* in, intersects a *cross-vein*, 129.

Composition of deposits containing the ores of antimony, } in talcose, micaceous, and chloritic rocks 179, 334,-7, 617.
——— ——— in clay-slate, 335,-7, 545,-8, 566, 707.
——— ——— in calcareous, alternating with hornblendic, rocks, 118, 617.
——— ——— in hornblendic and felspathic rocks, 121, 535,-6.
——— of deposits containing the ores of bismuth, } in talcose, micaceous, and chloritic rocks, 179, 334,-6,-7, 640.
——— ———, in clay-slate, 111, 334,-5,-6,-7, 374, 546.
——— of deposits containing ore of Chromium, 647—9.
——— ——— ores of Cobalt, 111,-12,-16,-21, 523—6; Table XVI.
——— of deposits containing copper and its ores, } in granite, 511, 675-80; Tables XXIII.—XXVI.
——— ———, in gneiss, 526.
——— ———, in micaceous, talcose, and chloritic rocks, 4, 6-8, 11, 15, 18, 373—8, 495, 596-7, 605—6, 638—41,—53.
——— ———, in felspathic and hornblendic rocks, 162—3,—5, 411—12, 420-38,-60-5,-8-73,-5,-9, 497, 535-6,-8, 735,-7.
——— ———, in clay-slates, 194—9, 545-50, 555-7,-64-9,-74-8, 676-7.
——— ———, in porphyry *(elvan)*, 441, 677, Tables XXIII. XXIV.
——— ———, in carboniferous slates, 605—8, 616—18.
——— ———, in carboniferous limestones, 618—19,—24—6.
——— ———, in the coal-measures, 503—5, 506—10.
——— ———, „ New Red Sandstone, 513—16.
——— ———, „ *Canga*, 236, 316.
——— of deposits containing gold, } in granite, 175, 311,-20,-32, 334,—7.

Composition of deposits containing gold, } in talcose, micaceous, and chloritic rocks, 177-80, 210,-47, 298, 300,-2,-11-12,-15, 320-1,-32,-4,-5,-7,-72-4, 383, 638-41.
——— ——— ——— in quartz-rocks, 181, 321,-32,-4, 337.
——— ——— ——— in clay-slates, 182-4,-94-9, 206, 207-10,-98-9, 312-13,-21-2, 328-9,-32,-4-5,-6; Table VI.
——— ——— ——— in calcareo-siliceous rocks, 245-9, 315,-23.
——— ——— ——— in *Itabirite* and *Jacotinga*, 212-216,-21-2,-4,-6-42,-6-7, 254-84,-6-98, 303-4, 313-14,-25-8,-30,-2,-5,-7; Table VIII.
——— ——— ———, in *Carvoeira*, 239-41.
——— of deposits containing ores of iron, } in granite, 175.
——— ——— ———, in micaceous, talcose, and chloritic rocks, 180,-4, 211-86, 298-99,300-2,-13,-16,-18

Composition of deposits affording ore of manganese, } in talcose slate, 495.
——— ———, in *Jacotinga*, 215,-19,-23,-63, 264,-5,-9, 303,-14.
——— ———, in *Carvoeira*, 239-40.
——— of deposits containing the ore of molybdenum, in micaceous slate and porphyry, 654.
——— of deposits containing the ores of nickel, } in gneiss, 521-6.
——— ———, in hornblendic rocks, 121.
——— ———, in the coal-measures, 503.
——— of deposits containing palladium, } in granite, 175, 311,-34,-7.
——— ———, in *Jacotinga*, 215,-19,-23,-63, 264,-5,-86, 335,-7,-8.
——— of deposits containing platina, } in *Jacotinga*, 248,–86, 335,–7, 338,–40.
——— of deposits containing silver and its ores, } in gneiss, 103, 521–6.
——— ———, in clay-slate, 105,–9–21, 545, 549,–66,–8, 708–11.
——— ———, in felspathic and hornblendic rocks, 533–8.
——— ———, in hornblendic, alternating with calcareous, rocks, 89–94, 98–121.
——— of deposits containing tellurium and its ores, } in talcose, micaceous, and chloritic rocks, 180, 299, 315, 334,–6,–7,–76,–82.
——— of deposits containing the ores of tin, } in granite, 77, 175, 359, 472-3, 486, 631,–64–5,–76,–8,–9.
——— ———, in clay-slate, 77, 202, 359, 472–3,–86, 630,–76,–80.
——— ———, in porphyry, 665.
——— of deposits containing the ores of zinc, } in gneiss, 525.
——— ———, in talcose, micaceous, and chloritic rocks, 617,–40.
——— ———, in clay-slate, 112, 545–7, 707.
——— ———, in hornblendic and felspathic, alternating with calcareous, rocks, 86.

Composition of rocks containing the ores of zinc, } in carboniferous limestone, 621.
——— of *cross-veins*, 125, 232,–86,–8, 330,–40–2, 439,–74, 526,-58,-98, 608,-82, 716.
——— of *slides*, 252, 439.
Conceicaõ, rich *bunches* of gold at, 216.
Concretionary structure, of hornblendic rocks, 702.
———, „ quartzose clay-slate, 702–3.
———, „ copper-ore, in granite, 512.
———, „ „ , in the coal-measures, 509.
———, „ „ , „ New Red Sandstone, [513.
———, „ lead-ore in clay-slate, 702–3.
———, „ iron-ore in the coal-measures, 66.
Conducting powers of rocks for heat, 753.
Condurrow, proportion of tin-ore in the vein-stone of, 472.
———, tin-ore of, separated from its matrix by the natural action of running-water, 354.
Conglomerate, 30,–9, 394–6, 403–4,–39,–74,–80, 501–3, 601.
Configuration of vein-stones and of the rocks which bound them, 188, 207,–23–4,–8,–30,–46,–59.
Connorree, the rocks of, 542,–63.
———, „ metalliferous deposits of; } their directions, dips, widths, compositions and structures, 545,—8,—9, 553,–63–8, 738.

Copper, ancient implements of, at Lake Superior, 412–19.
———, native, structure of, 431.
———, ———, specific gravity of, 429.
———, ———, proportion of, in the *lodes* and vein-stones of Lake Superior, 421,-6-7,-34-6,-40-1,-70-1,-3,-82,-8-9.
———, electro-deposited, structure of, 431.
———, ———————, specific gravity of, 429–30.
———, ———————, „ , after compression, 430.
———, smelted, structure of, 430–1.
———, specific gravity of, 429–30.
———, precipitation of, 562,–9–92; Table XVIII.[a]
———-mines, subterranean temperature in, 756–8,–61; Tables XXXIV. XXXV.
———-mining, ancient, in Chili, 154.
———————, „ , in Cornwall, 686–94.
Copper Falls, construction and operation of Stamping-machinery at, 426.
———————, costs of extracting (native) copper at, 426.
———————, expenditure and profits at, 459.
———————, subterranean temperature at, 733.
Cornwall Silver-mines, East, proportions of silver in the ores of, 115.
Cornwall, on the stanniferous granite of, 175, 664.
———, „ directions of *lodes* and *cross-veins*, in, 309, 674, 681, 704,–15.
———, „ silver-ores of, 110–18,–21, 710–11.
———, „ argentiferous lead-ores of, 118–20, 708–10,
———, „ displacements *(heaves)* of *lodes* in, 128.
———, „ subterranean temperature in, 752, Tables XXXIII. XXXIV. XXXV.
———, the miners of, frequently employed as Superintendents of mines in North and South America, 152.
Corri Charmaig, on the chrome-ore of, 643.
Costs of obtaining pyrites *(Sulphur-ore)* in Wicklow, 562.
——————— native copper at Lake Superior, 426.
——————— gold, by English Mining Companies, in Brazil, 327.
——————— „ in California, Table XXII.
Cotta, Prof. von, on the pyrites *(Sulphur-ore)* of Rammelsberg, 544, 546,—52.
Crennis, on the native silver and silver-ores of, 118.
———, produce and profits of, 456; Table XIV.

Crennis, East, produce, expenditure, and profits of, 459.
Crenver, ventilation of, 220.
———, *plunger-pole*, when used at, 570.
Crickitt, J. K. A., Esq., on a rich *bunch* of gold at *Gongo Soco*, 272.
Crofty, Wheal, tin-ore of, separated from its matrix by the natural action of running-water, 354.
Crofty, East Wheal, subterranean temperature at, 764—5.
Cromlechs in Upper India, 19, 28.
Cronebane, the rocks of, 541.
———, „ metalliferous deposits of; } their directions, dips, widths, compositions, and structures, 543–57.
———, „ „ , masses *(Horses)* of slate conformably enclosed in, 551,–3.
———, „ „ , mixed with auriferous silver, 549.
———, „ *cross-veins* in, their directions, dips, widths, and composition, 558.
———, „ „ , displace *(heave)* the metalliferous *(Sulphur-course)* deposit, 558.
———, dimensions of holes, weight of powder used, and quantities of stone broken in blasting at, 200.
———, precipitation of copper from mine-water at, 572–3,–87.
———, „ , introduced from Cornwall, 585.
———, subterranean temperature at, 738,–52; Tables XXXIII. XXXV

Cross-veins, compositions of, 125,-75, 226,-32,-87, 341, 439,-74, 527,-59,-98, 608,-22,-82, 716.
———, „ , in different rocks, 125, 608,-22,-82, [716.
———, structure of, 125,-6, 683.
———, do not always appear at the surface, 717.
———, sometimes of inconsiderable horizontal and vertical range, 129, 225,-32,-86, 341, 717.
———, appearances of their opposite *walls*, 71-2, 126, 439,-74.
———, influence of their widths on the extent to which they displace *(heave) lodes*, 685.
———, the same, *heave* the same *lodes* different distances at different depths, 717; Table XXVII.
———, „ , simply intersect a *lode* in one spot, yet *heave* it at another, 717; Table XXVIII.
———, *heave* a *lode*, but merely intersect certain of its *branches*, 598.
———, *heave* different *lodes* different distances at the same depths, 127.
———, *heave* different *lodes* in different directions at the same depths, Table XXIII.
———, different, *heave* the same *lodes* differently, 127, 558, 717; Table XXIV.
———, „ , *heave* different *lodes* similarly, 127; Table XXIV.
———, influence of the angles they include, on the extent of *heaves*, 127.
———, proportions of *heaves*, and of simple displacements, by, 684.
———, sometimes intersected by *lodes*, 129, 685; Tables III. XXIV.
Crowndale, ventilation of, 220.
Crozier, J. W., Esq., on the fall of rain at Ontonagon, 478.
Crystals of topaz, 307-8.
———, „ euclase, 307.
———, „ gold, 217,-36,-41, 302,-3,-56,-9.
———, „ „ , of different forms, are of unequal richness, 336.
———, „ copper, 431-2.
———, „ „ , their relations to the crystalline forms of their matrix, 432.
———, most abundant in the least productive parts of *lodes*, 89, 681.
Crystalline structure, more prevalent in the *cross-veins* than in the *lodes* of Chañarcillo, 125.

Crystalline action, determined in saturated solutions, by the introduction of solid substances, 713.
Cubert United mines, on the argentiferous lead-ore of, 120.
Cuddra, proportion of tin-ore in the vein-stone of, 472.
Cumba, proportion of gold in the *Jacotinga* of, 258.
Cumberland, proportions of silver in the lead-ores of, 108–9.
Cuming, — Esq., on the preparation of lime from shells in Chili, 155.

Damsel, Wheal, profits realized at, Table XIV.
Danda, on the copper-bearing beds of, 7.
Daniel, John, Esq., on the method and cost of stamping vein-stones near Lake Superior, 425–6.
———, „ „ of extracting large masses of native copper from the mines, 427.
———, „ precautions adopted to prevent the effects of cold in mines, 478, 734.
———, „ man-engine at the *Cliff* mine, 439.
Darlington, John, Esq., and Phillips, J. Arthur, Esq., on the produce, costs, and profits of mines, 459.
Darlington, West Wheal, on the silver-ores of, 116–17.
Darwin, Charles, Esq., on the valley of Copiapò, 140.
———, „ sounds occasioned by moving-sand, 140.
beds of shells at considerable elevations

Davis, Dr. E. H., and Squier, E. G., Esq., on ancient mining-works, weapons, and ornaments found near Lake Superior, 416,–18–19.
Davis, G. M. M., Esq., on the produce and profits of *Wheal Alfred*, 445.
Dawson, Principal, J. W., on the fossil Flora of New Brunswick, 505.
——————, „ copper-ores of the Nova Scotian coal-measures, 508.
Dawson, S. J., Esq., on the detrital gold of Canada, 384.
Dean, Arthur, Esq., on the auriferous deposits of Merioneth, 635,–8.
Débris, calcareous, filling joints in limestone at Chañarcillo, 75.
——, ferruginous, „ *Itabirite*, at *Agoa Quente*, 225.
Dechowree, on the iron-ores of, 40.
Declination, magnetic, 3, 69, 177, 372,–95, 405,–92, 511,–13,–15, 520,–31,–41, 603,-16,–37,–47,–73, 703.
Deepening mines, effects of, on the temperature of water entering them, 764.
Deflection of silver *lodes* by a metalliferous bed, 76, 82.
——— „ an auriferous deposit by a *cross-vein*, 232.
Delirio, extent and produce of works at, 124; Table XIV.
———, quantities and qualities of silver-ore obtained at, Table IV.
De Luc, M. A. J., on alternations of granite and slate at *Cook's-kitchen*, 658.
Deo (Devi) Dhoora, granite-veins in mica-slate at, 27.
——————, temple, artificial rock-basons, and cromlechs at, 27—8.
Depths, different, composition of metalliferous deposits at, 90–3, 103-21,-94-5, 201-203,-31-3,-5,-41,–79-80, 284, 338-40,-82, 436,-73, 535,-45-50,-65-8, 607-608,–16-21,-67-9,-705-9.
———, „ , widths of „ , 180, 685.
———, „ , hardness of „ , 199, 200, 473; Tables VII. XXII.
———, „ ; auriferous deposits at, proportions of gold afforded by, 203,-5,-30,-2, 235,-41,-5,-84, 331,-82.
———, „ ; „ , qualities of „ , 205,-85, 333.
———, „ ; „ , nature of alloy of „ , 206,–86.
———, „ ; „ , decline more rapidly in *Itabirite*, (*Jacotinga*) than in clay-slate, 331.

Depths, different, lead-*lodes* at, proportions of silver extracted from ore afforded by, 708-9.
———, „ , widths of *cross-veins* at, 685.
———, „ , extent of displacements *(heaves)* at, 685, 717.
———, „ , subterranean temperature at, 724—80 ; Tables XXXII.—XXXVII.
———, rate of increased, in mines, 448, 608, 748,-64-5.
Derbyshire, proportions of silver in the lead-ores of, 109.
————-, miners brought from, to work the mines of North Devon, [109.
Descoberta, rocks and auriferous deposits of, 298-9.
Descubridora, discovery of silver at, 69.
————, direction, dip, composition, and structure of the *lode* at, 91,-3.
————, extent and produce of works at, 124; Table XIV.
Desempeño, on the rocks of, 72.
————, directions, dips, and characters of the *lodes* at, 81, 90-2,
————, extent and produce of works at, 124 ; Tables IV. XIV.
Detritus, 42-3, 70.
———, auriferous, 3, 342-60,-84, 498, 627-33,-42; Table XXII.
———, stanniferous, 629-30,-95.
———, copper-bearing, 483-7.
Devonshire, stanniferous granite of, 175.
————-, proportions of silver in the lead-ores of, 109–10.
————-, *Consolidated Mines*, precipitation of copper at, 584,-92.

Diest, M. P. van, on the detrital tin-ore of Banca, 631.
Dietzsch, F. Esq., on the use of *sodium amalgam* in Brazilian reduction-works; Table XXII.
Dip, of metalliferous deposits, 4, 5, 7, 9, 11, 19, 20,-2,-5,-6,-8, 30, 33,-5-7,-9, 41, 71, 80-1, 161,-4, 310,-72,-75-7,-9, 408-9, 520-1, 532,-42,-75,-96, 604,-16,-18, 620-3,-37,-47,-52,-74, 704,-37.
—, „ , usually greatest when rich, 189, 270.
—, „ , greater when they have a N.—S. than an E.—W. direction, 405—9.
—, of auriferous deposits, generally, conformable to structure of the rocks adjoining them, 310,-72,-5-7,-9; Table X.
—, „ , „ , parallel to the contour of the nearest mountain ranges, 310; Table X.
—, of the greater number of *lodes*, towards the nearest granite, 675,—83.
—, alteration of dip on passing from *Manto* into limestone at Chañarcillo, 82.
—, of *cross-veins*, 124,-5, 439, 526,-58,-75,-98, 608,-22,-81,-5, 715.
—, „ , higher than the dip of *lodes*, 526, 682—3.
—, „ , towards the granite, 125, 682.
—, strata different on opposite sides of a *cross-vein*, 71, 82.
Ding Dong, proportion of tin-ore in the vein-stone of, 472.
Directions of metalliferous deposits, 4, 5, 7, 9, 11, 19, 20,-2,-5,-6, 28, 30,-3,-5,-7,-9, 41, 71, 80-1, 161,-4, 309,-72,-5,-7, 379, 408-10, 520-1,-32,-42,-75,-96, 603,-16,-18, 620-3,-37,-47,-52,-74, 707,-37; Tables I. II. X.
——— of auriferous deposits usually conform to the strike of the rocks above and below them, and to the directions of the neighbouring mountain-chains, 310,-72,-5-7,-9; Table X.
——— of *cross-veins*, 124-5, 439, 526,-58,-75,-98, 608,-22, 681,-5, 715.
Displacements, 127-35, 225-6,-32,-86-8, 341-2, 439,-74, 503,-27, 558-60,-75-6,-98, 600,-22,-81-5, 715-17. (See *Heaves. Intersections. Leaps. Throws.*)

Displacements, horizontal, of rocks by metalliferous *(veins)* deposits (?) 657—60.
———, „ , „ by *cross-veins*, 71, 126,-30-1,-3, 225–7,–86–7.
———, „ , „ „ (partial), 225–6, 286–7.
———, „ , of metalliferous deposits } by joints in the rocks, 183, 341, 559.
———, „ , „ by *cross-veins* of different widths. 127,—9, 558, 685.
———, „ , „ by the same *cross-vein* at different depths, 598, 685, 717.
———, „ , „ at some, but simple intersections only at other, depths, by the same *cross-veins*, 598, 717.
———, „ , „ by different *branches* of the same *cross-vein*, 598; Tables XIX. XXIII. XXIV.
———, by cross-veins of small

Displacements, horizontal, of metalliferous deposits containing gold, 183, 225, 232,-87, 341.
———, „ , of metalliferous deposits in granite, 683-5.
———, „ , „ in gneiss, 527.
———, „ , „ in clay-slate, 183, 493, 558-60,-98, 716-17.
———, „ , „ in *elvan* (porphyry), 684 — 5; Tables XXIII. XXIV.
———, „ , „ in felspathic and hornblendic rocks, 439, 474.
———, „ , „ in *Itabirite* and *Jacotinga*, 225-6,-86-7, 341.
———, „ , „ in calcareous, alternating with felspathic & hornblendic, rocks, 125—9.
———, „ , „ in the coal-measures, 503.
———, „ , extent of, 127-8, 439, 558,-75,-98, 684-685, 715-17.
———, „ , towards the greater angle, 127-8,-83, 341, 527,-58,-60,-75,-98, 684, 717.
———, „ , „ smaller angle, 127—8, 439, 558, 684, 717.
———, „ , „ right-hand, 127-8,-83, 341, 527,-58,-98, 683-4, 715-17.
———, „ , „ left-hand, 127—8, 341, 439, 474, 558—60,—75, 684, 715—17. (See *Heaves. Intersections.*)
Displacements, vertical, of rocks by metalliferous deposits (?), 657-660.
———, „ , „ by *cross-veins*, 71, 126,-30,-1,-3, 225,-86-7.
———, „ , „ „ of small vertical and horizontal range (partial), 225-6,-86-7, 342.

Displacements, vertical, in silver-mines, 71, 126,–30,–3.
————, „ , in gold-mines, 225–6,–86–7, 342.
————, „ , towards the greater angle, 126,–30,–1,–3.
————, „ , „ smaller angle, 225-6,-86-7, 341.
(See *Leaps. Throws. Intersections.*)
Dissemination, of metals and ores through rocks:—
gold, 175,-7,-86,-96, 255,-81,-99, 300,–2,-3, 313,-16,-20,-2,-73.
silver, 114,-19; Table IV.
copper, 403,-67,-75,-95, 500,-3,-9.
tin, 175, 664,-6.
Divining *(Dowsing)*-rod, the, still used in Dauphiny, 527.
Dœbereiner, M., on the platina alloyed with gold in the sands of the Rhine, 360.
Dol, on the graphite of, 40.
Dolcoath, on the rocks of, 447.
————, „ subsidence of the rocks *(Country)* and *lodes* at, 666.
————, „ native silver and silver-ores of, 113.
————, „ proportions of tin-ore in the vein-stone of, 472.
————, „ separation of tin-ore from its matrix by the natural action of running-water at, 354.
————, „ ancient works at, 146, 447.
————, „ improved system of mining at, 448, 645—7,

Douglas Houghton (Henwood) mines, on the *lode* of, 468-74.
———————————, „ proportions of (native) copper extracted from, and the cost of extraction, 471—3.
———————————, „ *(heaves)* displacements of the *lode* by a *cross-vein* and a joint, 474.
———————————, „ formation of ice underground at, 478, 734.
Downhill, altered value of land at, in consequence of mines having been opened in it, 694.
Drake Walls, on the conditions under which blasting takes place at, 200.
————, „ proportion of tin-ore in the vein-stone of, 472.
Dressing (washing and cleaning) auriferous pyrites, 198-9, 203, 357; Tables VI.[a] VII.
——————————— *Jacotinga*, Table IX.
——————————— quartz, cost of, Table XXII.
Drift, deposits of, 42, 460-84, 622.
——, „ , containing masses of native copper, 483,-7.
——, „ , „ „ gold, 342,-8,-58-9,-83.
——, „ , „ crystals of gold, 356,-9.
Duchanoy, and Rivot, MM., on the proportions of gold and silver in Hungarian ores, 100-1.
Duchy, Wheal, on the silver-ores of, 114—15.
Duck, gold discovered in the crop of a, 356.
Duckinfield-colliery, subterranean temperature at, 754-5.
Dufrenoy, M., on the detrital gold of Siberia, Table XXII.
Du Noyer, G. V., Esq., on the rocks, *lodes*, and submarine works at *Knockmahon*, 593-7,-9-601.
————, ————, „ rocks and *lodes* of Kenmare, 611, 616,-18,-21-2.
————, ————, „ limestone of Brownstown, 622.
Dupee & Co., Messrs., on the production of copper at Lake Superior, 488—9.
Durham, proportions of silver in the lead-ores of, 108.
Duraõ, Capt. Paulo Rodriguez, iron-ore smelted by, 237.
———————————, native copper and gold obtained by, 236.

Durocher, M., on the proportions of silver in the ores of Norway, 100.
Duties, Dues (Royalties), &c., 62-3, 208,-89, 347,-60-70, 442-7,-9, 451-4,-6-60, 588; Tables VII. IX. XIV.
Duval, G. V., Esq., on the gold-deposits of *Gongo Soco*, 258,—72; Table XXII.
Dwarra Hath, on the granite of, 2, 29.
————, „ detritus near, 45.
————, „ temples at, 3.

Eardiston, on deposits of copper-ore in the New Red Sandstone of, [515.
————, „ subterranean temperature at, 515, 750.
Earnings by miners and smelters in Upper India, 60—1.
——— „ washers for gold (Feiscadores) in Brazil, 358.
——— „ miners in Australia, Brazil, Chili, and Nova Scotia, Tables V. XXII.
——— „ Superintendents in Chili, Table XXII.
Earthquakes, 49, 157.
————, elevation of land in Chili by, 157–8.
Edinburgh, extreme and mean temperatures at the surface and underground at, 777.
Education of black (slave) children in Brazil, 295–6.
Edwards, Mr. T. W., on the iron-formation of *Antonio Pereira*, 213.
Eels in mine water at *Betallack*, 717.

Entrances to Chilian mines closed by locked gates, 91.
Enys, J. S., Esq., on the jointed structure of granite, 75, 672.
Epidote, occurrence of, 80, 398,
Eschwege, Baron von, on the elastic sandstone of Villa Rica (Ouro Preto, 172, 210.
——————, „ *Itacolumite* of Brazil, 172.
——————, „ clay-slate of „ , 173.
——————, „ alternations of *Itacolumite* and clay-slate, 211, 312.
——————, „ *Itabirite* of ..... Brazil, 172, 211, 298.
——————, „ *Carvoeira* of ..... „ , 237—8.
——————, „ gold-mines of, ... „ , 184, 244, 300–1.
——————, „ crystals of gold in the *Canga* of, „ , 217.
——————, „ quantities of gold obtained in „ , 366.
——————, „ iron-ores and furnaces of, „ , 175, 213, 236–7.
——————, „ topaz-mines of..... „ , 306.
Esperanza, extent and produce of the works at, 124; Table XIV.
——————, quantities and qualities of the ores obtained; Table IV.
Etheridge, Robert, Esq., on shells in the raised beaches near Caldera, 156.
——————, „ plants in the coal-measures of New Brunswick, 504–5.
Euclase, matrix of the, in Brazil, 308.
Europeans employed in the mines of Chili and Brazil, 152; Tables V. VI.[a] IX.
Evans, T. F., Esq., on the different qualities of water at *Mona*, 584.
——————, „ precipitation of copper and production of ochre..... „ , 580-4; Table XVIII.[a]
——————, „ rain..... „ , 582.
Evaporation, different amounts of, affected the speed of the water-wheels at *Gongo Soco*, 351.
Exmouth and Adams, Wheal, proportions of silver in the lead-ores of, 110.
Expectativa, on the New Red Sandstone, and the copper-ores obtained from it, at, 514.

Expectativa, on petroleum of, 516.

Fahlun, on the ores of, 543.
———, „ use of fire to aid operations of the miners at, 51.
———, on an accident at the works of, 665.
Fairbairn, W., Esq., on subterranean temperature at *Duckinfield*, 754.
Faiscadores *(gold-streamers)*, their modes of work and earnings, [357—8.
Fall of water, on ventilation by means of a, 219—20.
Falmouth, East Wheal, proportions of silver in the lead-ores of, 120.
Falmouth, Wheal, precipitation of copper by lime at, 585.
Falmouth Harbour, injury to, by sand and mud from the mines, 353.
Faraday, Dr., his analysis of the magnesian limestone of } *Gongo Soco*, 173, 298.
————, „ the iron ores & slags of } „ , 261.
Farmers of Royalties, their proportions of iron-ores raised in Kumaon, 55,—9.
Featherstonhaugh, G. W., Esq., on the auriferous deposits of } Virginia, 322,-84.
————————, „ detrital gold of, „ , 384.
Felspathic clay, 3, 228,–40,–3, 307, 423.
——— rocks, 154, 388, 492, 517,–30–1,–3,–41,–94, 636,–71, 701–2,–36.
————, temperatures of mines in, 755–8; Tables XXXIII. XXXV.

Food, cost of, in Chañarcillo, 150; Table V.
——, of slaves in Brazil and Virginia, 292, 382.
——, of serfs in Siberia, 348.
Forbes, David, Esq., on the auriferous deposits of Merioneth, 636-9.
——————, „ quality of the gold of „ , 642.
——————, „ detrital gold of Bolivia, 360.
Forbes, Principal J. D., on the climate of the Alps, 528.
——————, „ temperature at the surface and at various depths near Edinburgh, 777
Forbes, Sir John, on a spring of fresh-water beneath the sea at *Botallack*, 539.
Forests, 21, 55, 61, 296, 390, 416.
——, succession of different growths in, 416.
——, destruction of, 21, 55–6, 343,–90.
——, „ , consequences of, 344.
Forest mine, ancient implements discovered in the, 415.
Forges underground at *Bearhaven* and *Wheal Vor*, 610
Forster, Westgarth, Esq., on *pipe-veins* of lead-ore, 620.
Fossiliferous rocks of the Liskeard ... district, 700.
——————— „ Merioneth „ , 636.
——————— „ Wicklow „ , 540.
——————— „ Waterford „ , 593,–5.
——————— „ Kerry „ , 613.
——————— „ Meath „ , 623,–5.
——————— „ New Brunswick „ , 503,–4.
Foster, C. Le Neve, Esq., on the Molybdenite of Mount Sorrel, 654.
Foster (J. W., Esq.) & Whitney (J. D., Esq.), on the rock-formations of Lake Superior, 385—404,–39.
——————, „ iron-ores of Lake Superior, 388-9.
——————, „ copper-*lodes* of „ , 405—412,–20–5,–7–8,–31–4, 436,–9, 466-7,-75,-7.
——————, „ native silver of Lake Superior, 419,–36–7.
——————, „ *cross-vein (Slide)* at the *Cliff* mine, 439.
——————, „ drift of Lake Superior, 483—5.
——————, „ ancient mining-works near Lake Superior, and on the weapons, tools, and implements found in them, 412–17,–19,–75.
——————, „ temperature at Fort Wilkins, 477.

Foster (J. W., Esq.) & Whitney (J. D., Esq.), on the temperature of the water in Lake Superior, 477.
——————————, „ subterranean temperáture, 733–4.
——————————, „ amount of rain at Fort Brady, 477.
Fowey Consolidated mines, on the native silver of, 118.
——————————, „ produce and profits of, 456; Table XIV.
Fox, Robert Were, Esq., on the structure of *cross-courses*, 461.
——————————, „ subterranean temperature, 723,–60–1, [762,–5.
Fraga, on the auriferous talc-slate of, 301,–20, 732.
——, „ subterranean temperature at, 732.
Francis, Capt. Francis, on subterranean temperature at *Wheal Vor*, 764.
Francis, Mr. Henry, on the coincident directions of *lodes* and glens in West Cornwall, 718.
Francis, Mr, William, on the gradual filling of Carnon valley with sand and mud from the mines, 353.
Francisco Nuevo, San, extent and produce of the works at, 124; Table XIV.
——————————, quantities and qualities of silver-ore obtained from, Table IV.
Francisco Viejo, San, extent and produce of the works at, 124; Table XIV.
——————————, quantities and qualities of silver-ore obtained

Fuller, Dr. Thomas, on the silver of North Devon, 109.
Furnaces, Himalayan, blast supplied by air-bags of skin, worked by hand, 54—5.
———, Brazilian, blast supplied by fall of water into a pneumatic trough, 219,-60-1.
Furze Hill Wood, proportion of tin-ore in the vein-stone of, 472.

Gad and pick, skill of Cornish miners in using, 152.
Galena, 100–10,-16-21, 376-7, 545,-8-9, 615,-20,-40, 703,-8-11.
———, argentiferous, 100–10,–16–21, 545,–8–9, 615–20,-(?) 40, 703,-8-11.
———, „ , enclosing threads of native silver and masses of vitreous ore, 120–1.
———, auriferous, 100, 378, 549, (?) 640.
Gallà, iron-mine of, 22; Table I.
Gama, Col. Ignacio da, on the gold-mine of *Catta Preta*, 237.
Gambling, propensity of Chilian miners towards, 91.
Garby, John, Esq., on the native silver and silver-ores of Cornwall, 118.
Gardner, Dr. Daniel, on the gold-mine of *Catta Preta*, 237.
Gardner, George, Esq., on the gold-mines of Brazil, 170,-85, 245, 303, 500-2.
———, „ detrital gold of „ , 343.
———, „ fishes of ..... „ , 354—5.
———, „ scenery of..... „ , 169, 297.
Garnets in the copper-bearing rocks of Chili, 161.
——— „ auriferous deposits of Virginia, 381.
Garnett and Moseley mines, on the rocks of the, 379–81, 732.
———, „ auriferous deposit of the, 381-3.
———, „ proportions of gold at different depths in the, 383.
———, „ quality of the gold, 381.
———, „ detrital gold of the neighbourhood, 384.
———, „ subterranean temperature at the, 733.
———, „ food of the slaves at the, 382.
Garras (Guarneck), proportions of silver in the lead-ores of, 118.
Garras, South, proportions of silver in the lead-ores of, 120.
Gas, issue of, from joints in the *Itabirite* at *Gongo Soco*, 250.
——, inflammable, from crevices in the auriferous formation at *Morro Velho*, 195—6.

Gas, inflammable, from vegetable matter overlying stream-tin-ore near Perran Wharf, 453.
——, coal, used for lighting the underground works at *Balleswidden*, 669.
Geach and Webb, Messrs., on the Caradon, Menheniot, Lanreath, and Saint Pinnock districts, 659,-61,-4-5,-76-7,-95, 704,-15-16.
Geikie (Archibald, Esq.) and Murchison (Sir Roderick Impey), on the gneissose rocks of Breadalbane, 646.
Georgia, on the auriferous rocks of, 371.
———, „ an ancient Indian village entombed in the auriferous drift of, 384.
Gesner, Dr. A., on copper-mining in New Brunswick, 506.
Geyserberg, on the stanniferous porphyry of, 665.
Gilbert, C. S., Esq., on the silver-ores of Cornwall, 111,—14.
Gilbert, Davies, Esq., on the argentiferous lead-ore of *Wheal Rose*, 119.
Giles, Mr. John, on the slates of the Caradon district, 667.
———, „ „ Liskeard group, 700.
———, „ *elvans* of Caradon, 671.
———, „ felspathic and hornblendic rocks of Saint Cleer and Menheniot, 672, 701.
———, „ *lodes* of Menheniot, Lanreath, and Saint Pinnock, 699–702,-6,-12.

Gold, of Ireland, 549-50, 627-34; Table XXII.
——, „ New Granada, 360.
——, „ the Rhine, 348,-56,-8,-60; Table XXII.
——, „ Siberia, 175,-7, 335-6,-40,-2,-3,-5,-6,-8,-60; Table XXII.
——, „ Virginia, 371-84; Table XXII.
——, „ Wales, 635-42; Table XXII.
——, disseminated through granite, 3, 175, 320.
——, „ talcose, micaceous, and chloritic rocks, 177, 300-3,-20.
——, „ quartz-rocks, 316.
——, „ clay-slate, 186,-96, 210.
——, „ calcareo-siliceous rocks, 245,-9, 304, 315,-19,-23-4.
——, „ *Itabirite (Jacotinga)*, 215,-19,-21,-42.
——, „ *Carvoeira*, 240.
——, „ *Canga*, 217, 315-16,-19.
——, limited to certain portions or beds of granite, 175, 311,-20,-34.
——, „ talcose, micaceous, and chloritic rocks, 176-7,-80, 298, 302, 311-12,-15,-19,-20,-34,-72, 636,-42.
——, „ quartz-rocks, 178-9,-80-2, 312, 334.
——, „ clay-slate, 182,-3,-4, 312-13,-17, 318,-20,-35,-49-50,-76.
——, „ calcareo-siliceous rocks, 636-42.
——, „ *Itabirite (Jacotinga)*, 214,—16, 221,-7,-35,-42,-6,-62-82, 313-314,-18-19,-25,-35,-75.
——, „ *Carvoeira*, 240.
——, „ which conform to the cleavage of the rocks, 178,-80,-2,-3,-4,-7, 188, 207,-14,-16,-21,-3,-7, 243,-5,-9,-98, 300,-1,-2,-9-23, 372,-5,-7,-80.
——, „ which conform to the joints, 181, 187,-8,-91, 207,-21,-3,-99, 323.
——, limited to certain portions or beds of rock, which conform neither to cleavage-planes nor joints, 637.

Gold, matrix of, its composition, in granite, 46, 175, 311,-32,-4,-7.
——, „ , „ , „ talcose, micaceous, and chloritic rocks, 177–80, 209-11,–47, 298-303,-11-12,-15,–20–1, 332,-4-7,-72-83, 639-42.
——, „ , „ , „ quartz-rocks, 181, 321,-32,-4,-7.
——, „ , „ , „ clay-slates, 182-4,-94-9, 206-7, 210,-98-9, 312-13,-21-2,-8–329,–32,–4,–5,–6,–7; Table VI.
——, „ , „ , „ calcareo-siliceous rocks, 245-9, 315,-23-4.
——, „ , „ , „ *Itabirite (Jacotinga)*, 212—16, 221–4,-6–35,-42,-5-7,-54-84, 286,-98, 303–4,–13–14,–24–330,-2,-4-7; Table VIII.
——, „ , „ , „ *Carvoeira*, 239-41.
——, „ , dip of *(Shoots)* masses coincident with indulations of rocks, 206-7,-15,-16,-34,-59,-64,-9, 319,-23,-6.
——, most plentiful in most highly inclined portions of formations, 189, 270,-81, 310.
——, relation between it and the structure of its matrix } of pyritic quartz in clay-slate, 184,—97.
——, „ of *Jacotinga (Itabirite)*, 259,-70,

Gold, proportion of, contained in certain beds } of quartz-rocks, 182, 321.
——, „ , „ of clay-slate, 184,-96-8, 201-6, 327,-79.
——, „ , „ of *Itabirite (Jacotinga)*, 230-2, 235,-79-81, 326,—7.
——, „ , obtained from different } parts of the same formation, 383.
——, „ , „ depths in the clay-slate series, 201-5, 331; Tables X. XXII.
——, „ , „ „ *Itabirite (Jacotinga)*, 230-2,-5,-79-81, 331; Tables X. XXII.
——, „ , „ „ *Carvoeira*, 241.
——, „ , *(nuggets)* masses and of dust in *Itabirite (Jacotinga)*, 274-7, 330.
——, analysis of, 334,-5,-60,-74.
——, quality of, in granite, 332.
——, „ , „ talcose, micaceous, and chloritic rocks, 332,-74, 383, 642; Table X.
——, „ , „ clay-slate, 205-6, 332,-83; Table X.
——, „ , „ *Itabirite (Jacotinga)*, 236,-85-6, 332,-3; Table X.
——, „ , at different depths in the same formations, 205-6, 333,-75; Tables VII. X.
——, „ , differs in crystals of different forms, 335.
——, nature and proportion of its alloy } in granite, 175, 334,-7
——, „ „ talcose, micaceous, and chloritic rocks, 179,-80, 299, 334,-7,-74, 382, 642.
——, „ „ quartz-rocks, 334,-7.
——, „ „ clay-slate, 206, 334—5,—7,—40, 377–8.
——, „ „ calcareo-siliceous rocks, 642.
——, „ „ *Itabirite (Jacotinga)*, 236, 335,-7. 340.
——, „ „ at different depths in the same rocks, 206,-86, 338,-40; Tables VII. X.

Gold, alloyed with antimony, 179,-80, 334-7,-74.
——, „ arsenic, 335,-7,-74.
——, „ bismuth, 174, 334-7,-74.
——, „ copper, 286, 335-7,-40,-59,-74,-5, 642.
——, „ iron, 335-6,-74, 632,-42.
——, „ lead, 335-7,-40,-74,-7.
——, „ palladium, 175, 215,-86, 335-7,-40,-59.
——, „ platina, 286, 335-7,-40,-60.
——, „ silver, 236,-86, 334-5,-7,-40,-59,-60,-74,-7,-8, 632-42.
——, „ tellurium, 180, 299, 334,-6-7,-82.
——, molten, of higher specific gravity than native, gold, 335.
——-mines, temperature of, 725—33,—56—8 ; Tables XXXII.—XXXVI.
——, detrital, ancient deposits of, 342–51,–83–4, 627–33,–42; Table XXII.
——, „ , recent „ , 46, 283, 348,-52-9,-84.
——, „ , contains the same alloy as the gold of the neighbouring mines, 359.
——, „ , always of superior quality to mine-gold, 359-60, 632.
——, „ , crystals of gold not uncommon, 356,-9, 632.
——, „ , shaped implements sometimes mixed with, 344–5.
——, „ , proportions of, extracted from sand and gravel, 346, [358.
——, „ , occasionally swallowed by water-fowl, 356.

Gonamena, on the subterranean temperature at, 746.
Gongo Soco, the rocks of, their direction and dip, 248—9.
———, „ , joints in, 250.
———, „ slate (auriferous at *Camara*), 183, 247, 327,-41.
———, „ calcareo-siliceous matter mixed with particles of gold, 249, 304,-19.
———, „ *Itabirite*, 249,-97, 313.
———, „ „ , mass (*Horse*) of, imbedded in (yet containing lines of) auriferous *Jacotinga*, 251, 324; Table VIII.
———, „ „ , displaced by small *cross-veins*, 286—8, 341.
———, „ *Jacotinga*, the *Gongo* formation, 250, 252-4.
———, „ „ , „ *Cumba* „ , 252-4, 256-8,
———, „ „ , „ „ „ , both conform to the direction, dip, and cleavage of the rocks above and below them, 248, 310,—25.
———, „ *Jacotinga*, the *Cumba* formation, at times thinly sprinkled with gold, 255.
———, „ „ , productive, mostly, on certain parallel lines (*veins*) in both, 255,-7,-62,-4,-5,-82.
———, „ „ , productive, mostly, on certain thin lines (*veins*) of limited horizontal & vertical range, 257,-65-7,-70,-1,-82.
———, „ „ , productive on the same meridian 269,-70.
———, „ „ , productive masses (*shoots*) of, all dip (endlong, with the groovings of the rocks), towards the E., 259,-63,-4,-6, 270,-82.
———, „ „ , productive portions the most highly inclined, 281, 310.

Gongo Soco, the rocks of *Jacotinga*, productive, composition of, 263-269, 314,-25-7.
———, " " , " , hardness of, 283–4.
———, " " , " , disposition of masses (*nuggets*) and particles of gold in, 271—80.
———, " " , " , proportions of gold contained in, 274–7,-9-81; Tables X. XXII.
———, " " , productive, quality of gold contained in, at different depths, 285, 333 ; Table X.
———, " " , nature & proportion of alloy of gold contained in, at different depths, 286, 338; Table X.
———, " " , productive, lines take, at times, the directions of the joints, 264.
———, " " , productive, influence of the *Slide* on, 252,-67,-70.
———, " " , unproductive portions of, 270.
———, " " , masses (*bunches*) of iron-ore wrought, 260–1.
———, " magnesian-limestone, 297–8.

Gorland, Wheal, on the profit made at, 451; Table XIV.
Goron, on the copper-bearing talc-slate of, 5.
Gossan, a matrix of copper-ore, 162,-5,-7, 545,-64,-95, 605,-16,
———, „ lead-ore, 706-7. [624,-39,-76,-8.
———, „ silver-ore, 525,-34.
———, „ gold, 167,-83, 299, 301,-2,-12,-73,-5-7,-81, 549, 639.
Graham (Callcott), Mrs., on the elevation of the coasts of the Pacific by earthquakes, 157.
Granada, New, on the different qualities of mine and detrital gold in, 360.
Granite, composition of, 2, 29, 170,-4-6, 247, 311,-85-7, 662-4,
———, auriferous, 3, 175-6, 311,-16,-20. [666-7,-72.
———, quality of gold in, 332.
———, alloy „ , 334.
———, stanniferous, 175, 664-6.
———, cupriferous, 512.
———, structure of, 3, 316,-85, 512, 673.
———, cavern in, 27.
———, position of, in opposite sides *(walls)* of *lodes*, 657-60,
———, interlying slates, 658-9. [669-70.
———, veins of, 3, 27, 386-7,-91, 490-2, 512.
———, relation of its contour to the cleavage of contiguous slates, 259,-310.
———, relative position to the dips *(shoots)* of ore in *lodes*, 32,
———, rate of blasting in, 200. [122, 259.
———, quantity of it shipped from Cornwall, 666-7.
———, subterranean temperature in, 756,-8,-60-1; Tables XXXIII.
Graphite in the clay-slate of Upper India, 41. [XXXV.
Grasty (Chancellorsville), auriferous rocks of, 372-5.
Gravel, beds of, at great altitudes, 45, 66, 70, 156.
Gravity, specific, of native copper, 429.
———, „ , „ electro-deposited copper, 429-30.
———, „ , „ „ , after compression, 430.
———, „ , „ smelted copper, 429-30.
———, „ , „ native gold, 335, 431, 632.
———, „ , „ molten „ , 335, 431.
Great Work, proportion of tin-ore in vein-stone of, 472.
Greenstone, 79, 398, 496-7,-9, 650-1.
————-slate, 499, 512.

Greenstone, dykes of, 80.
Greenwich, extreme and mean temperatures at the surface and at various depths, 776–7.
Greer, R. J., Esq., on the mean temperature of Waterford, 739.
Gregg (R. H., Esq.) & Lettsom (W. G., Esq.), on the silver-ores of Cornwall, 116,-18.
Gregory, Capt. Thomas, on the rate of blasting at *Drake Walls*, 200.
———————, „ proportions of tin-ore in the vein-stone of } „ , 472.
Grylls and Basset, proportion of tin-ore in the vein-stone of, 472.
Gualaxo, character of gold obtained from the, 359.
Guernsey, on the climate of, 735.
Gueymard, M. E., on the rocks of ..... *Chalanches*, 518–19.
———, „ metalliferous deposits of „ , 519–26.
———, „ climate of the Alps of Dauphiny, 528.
Guias de Carvallo, veins *(branches)* of, 81.
———————, horses worked underground at, 76.
Gungolee, on the copper-mines of, 4, 5.
Gunnai, auriferous sands of the Ramgunga near, 5.
Gunnis Lake, produce and profits of, 457; Table XIV.
Gurhwal, on the iron-furnaces of, 57.
———, Government Royalties of, 62–3.
Guy, Capt. Benj., proportions of gold from the calcareo-siliceous formation at *Gongo Soco*, 249.

Harris, Capt. N., on the manufacture of iron at *Gongo Soco*, 262.
Harris, Sir W. Snow, on the climate of Plymouth, 745,–9.
Hartz, proportions of silver in the lead-ores of the, 101.
Haughton, The Rev. Dr., on the deposits of sulphur ores in Wicklow, 547,–53,–5–7.
———————, „ rocks of the Kenmare district, 611–614.
———————, „ metalliferous deposits „, 614–621.
———————, „ *cross-vein* at *Ardtully*, 622.
———————, „ *drift* at Kenmare, 622.
———————, „ precipitation of copper at *Ballymurtagh*, 574.
———————, analysis of the hematite of *Ballymurtagh*, 547.
———————, „ limestone of Kerry, 613.
———————, „ grey copper-ore of Ardtully, 617.
Hawkins, John, Esq., on the *throws* of *lodes* in Cornwall, 226.
———————, „ copper-ores of the Parys mountain, 574,–6.
———————, „ stanniferous porphyry of Geyersberg, 665.
Heaves, 127-35, 225-6,-32,-86-8, 341-2, 439,-74, 503,–27,–58–60, 575–6,–98, 600,–22,–81–5, 715–17.
(See *Displacements. Intersections. Leaps. Throws.*)
Heber, Bishop, on the frequency of earthquakes in Kumaon, 49.
Helmreichen, H. Virgil von, on displacements of beds of auriferous granite at *Candonga*, 176.
———————, on the geology of *Gongo Soco*, 170, 250,-63,-6,-8, 315,-54.
———————, „ manufacture of iron at *Gongo Soco*, 262.
———————, „ calcareous rocks of *Antonio Pereira*, 304.
———————, „ flint arrow-heads from diamond-washings in Brazil, 344.
———————, „ Magnetic declination in Minas Geraës, 177.
Helston, subterranean temperature in the district of, 752.
Hemp, rope of, inferior to iron-wire rope, 143.

Hender, Wheal, proportion of silver in the lead-ore of, 120.
Hennezel, M. de, proportion of silver in the lead-ore of Bohemia, 101.
Henry, Dr. William, on the argentiferous lead-ores of } *Crone Bawn*, 745.
——————, „ precipitation of copper at } „ , 572.
Henwood, contact of granite and slate at, 655,—7.
Henwood, Mr. John, a shareholder in the first Cornish silver-mine, [111.
Henwood mines, 465–79. (See *Douglass Houghton.*)
Herbert, Capt., on the auriferous granite of Kedarnath, 3.
——————, „ „ sands of the Aluknunda, 46.
——————, „ metalliferous rocks of the Himalaya, 12, 21.
——————, „ mines and smelting-works of } „ , 21,—5, 41, 55.
——————, „ drainage of the Dehra Doon, 42.
——————, „ disappearance and reappearance of rivers in the Terrai, 44.
Herland, on the silver and silver-ores of, 111—12.
Herm, on the metalliferous deposits of, 736—7.
——, „ subterranean temperature at, 737.
Herod's-foot, on the rocks of, 700; Table XXII.
——————, „ organic remains they contain, 700.
——————, „ *lode* of, 704—15.
——————, „ proportions of silver contained in the lead-ores

Higgs, Samuel, Jr., Esq., on copper-ore in the New Red Sandstone of Alderley, 516.
Hilaire, M. A. de Saint, on the gold-mines of Brazil, 185, 237,-43-4.
———————, „ implements used in them, 218.
———————, „ iron-furnaces of Giraõ, 218.
———————, „ detrital gold of Brazil, 342.
———————, „ scenery and vegetation } „ , 168, 209-10, 236.
Hill, — Esq., on the direction, dip, width, and composition } of the *Cliff lode*, 423.
———, „ occurrence of native silver } in „ , 436.
Hill, W. G., Esq., on the proportion of tin-ore in the vein-stone at *Wendron Consols*, 472.
Himalaya, Mining in the, 4—42.
———, inefficient tools used by miners in the, 51—3.
———, iron-smelting in the, 53—62.
———, varied occupations of the inhabitants of the, 56.
———, earnings ..... „ , 60—1.
Hind, H. Y., Esq., on the granite of New Brunswick, 490,-1,-3.
———————, „ micaceous slates of „ , 499.
———————, „ sandstones and conglomerates of } „ , 501,-2,-3.
———————, „ cupriferous shales of „ , 503,-6.
———————, „ copper-ores of „ , 500.
———————, „ detrital gold of „ , 498, 500.
Hitchens, Capt. Joel, on the auriferous deposit of *Agoa Quente*, 233.
Hitchins, The Rev. M., on the silver and silver-ore of *Herland*, 111.
Hoare, J. S., Esq., on the detrital gold of Wicklow, 633.
Hocheder, J. C., Esq., on the auriferous deposit of *Gongo Soco*, 173, 251,-5,-6,-60,-2,-5,-9,-71,-3,-4; Table XXII.
Hockin, John, Esq., on the qualities of gold from different depths in *Morro Velho* ..... } 205.
———————, „ nature of the alloy of } „ , 206.
———————, „ analyses of ... „ , 334,-74.
———————, „ rate of blasting „ , 200.
———————, „ rain-fall at *Morro Velho*, 349.
———————, „ climate of „ , 726.
———————, „ subterranean temperature at } „ , 727.

Hodge, John, Esq., on the (sulphur-ore) / pyrites of Wicklow, 545,-7,-8,-66.
———, „ copper-ores... „ , 547–8.
———, „ auriferous iron-ores of *Ballymurtagh*, 550.
———, „ unfavourable influence of *cross-veins* on the *Sulphur-course* of Ovoca, 560.
———, „ displacements *(heaves)* of the „ , 558.
———, „ detrital gold of Wicklow, 629. [559,-60.
———, „ precipitation of copper at *Ballymurtagh*, 574–8.
Hoffman, Prof., on the dissemination of gold through granite and slate, 175.
Holdsworth, — Esq., on the rocks of Bonmahon, 597.
Holes, experiments on boring and blasting, 199, 200; Tables VII. XXII.
Holl, Dr. H. B., on the hornblendic rocks of the Caradon district, 662.
———, „ fossiliferous „ „ Liskeard „ , 701.
Hollingshed, R., Esq., on the proportion of silver in the lead-ores of Devon, 109.
Hollow, Capt. W., on the proportion of tin-ore in the vein-stone of *Providence Mines*, 472.
Holman, Capt. James, on the ventilation of mines, 220.
Holmbush, on the proportions of silver in the lead-ores of, 120.
Hooker, Dr. J. D., on the Coal of Fitcooree, 65.

Horses, (masses) of clay-slate in *lodes*, 190,—4, 312,-17,-28, 550, 551,-68; Tables XXVII. XXVIII. XXIX.
——— „ felspathic and hornblendic rocks, in } *lodes*, 424; Table XVII.
——— „ limestone..... „ , 84.
——— „ *Itabirite* enveloped by *Jacotinga*, 250–1.
——— „ „ intersected by *cross-veins*, 287.
——— „ micaceous and oxydulated iron } imbedded in *Carvoeira*, 240.
——— „ carboniferous slate „ *lodes*, 605.
——— „ „ limestone „ „ , 618,-20,-4.
——— penetrated by lines of the ores which envelope them, 251, 551,-96, 713.
———, their cleavage-planes mostly coincide with those of neighbouring slates, 23, 190, 251, 324, 551,-64,-96, 605, 713.
———, „ are not always coincident, 713.
Horses and mules, their liking for water holding iron-ores in suspension, 354.
Houghton, Dr. Douglass, on the metalliferous rocks of Lake Superior, 487.
———————, „ masses of native copper in the *drift* of } „ ,484.
Howe, T. M., Esq., on financial operations at the *Cliff* mine, 440; Table XIV.
Huidobro, ores of copper in New Red Sandstone at, 77, 513–16.
———, petroleum obtained from „ , 516.
Huldwanee, works of irrigation at, 43.
Humboldt, M. A. de, on the disposition of silver-ore in veins, 327.
———————, „ proportions of silver in the ores of Mexico, Peru, and Chili, 97–9.
———————, „ comparative values of wheel-barrows & tram-waggons in mines, 145.
———————, „ loads brought to the surface by Mexican labourers, 147.
Humming-birds, their nests and note, 181.
Hungary, proportions of gold, silver, and lead in the ores of, 100-1.
Hunt, Robert, Esq., on the proportions of silver in the lead-ores of the British Isles, 105,-6,-7,-8,-9,-10, 120.

Hunt, Robert, Esq., on the produce and proportions of silver in lead-ores of East Cornwall, 708-9,-20.
——————, „ produce of copper-ores in East Cornwall, 698.
——————, „ „ silver-ore at *Wheal Ludcott*, „ 711.
Hurchinolee, on the iron-ores of, 33,—5.

Ice, formation of, in grounds where the Bamboo flourishes, 45.
—, „ , in mines, 465,-78-9, 734.
Inclination of paths by which ores are taken out of the Mexican and Chilian mines, 147.
Indiana mine, on the rocks and *lodes* of the, 464.
Inficionado, auriferous detritus of, 343.
Intersections, unaccompanied by displacements,—
—————— of rocks by metalliferous deposits, 81,-122,-87, 318, 420,-3, 460,-3,-4,-5,-7,-79,-80, 515,-20,-31,-2,-64,-96, 603,-25,-57,-60,-8,-9, 674, 704.
—————— „ „ , which are elsewhere themselves intersected by the same rocks, 192, 318.
—————— „ „ , which are deflected by them in the same mines, 82.

Intersections, unaccompanied by displacements,—
——— of metalliferous deposits by various *branches* of the same *cross-veins*, 598; Table XIX.
——— „ by *cross-veins* of small vertical & horizontal range, 125, 287, 342.
——— „ by different *cross-veins*, Table XXIV.
——— of various *branches* of metalliferous deposits by the same *cross-vein*, 598; Table XIX.
——— of *cross-veins* by metalliferous deposits, 125,—9.
——— „ „ , which are intersected by similar *cross-veins* elsewhere, 125,–9; Table III.
——— „ of small vertical and horizontal range by metalliferous deposits, 125,–9; Table III.
——— „ by other *cross-veins*, 685; Table XXIV.
———, accompanied by dislocations (See *Displacements. Leaps.*)
Ireland, mines of, 540—642.
———, detrital gold of, 627—34.
———, subterranean temperature in, 737–44,–52.
———, precipitation of copper in, 569-89; Table XXXII.
Iron, ores of, in granite, 175, 311, 674,–8.
——, „ , „ gneiss, 522,–5,–7.
——, „ , „ talcose, micaceous, and chloritic rocks, 19–24, 177, 180, 300-4,-73,-5,-7,-9,-81,-8, 639,-47-9,-53,-74.
——, „ , „ quartz-rocks, 33,–5,–7, 181.
——, „ , „ clay-slates, 21,-5-9,-30,-4,-6,-41-2, 183-4,-94,-6,-7, 312,-21-2,-9,-73,-7,-9, 545,-69,-74,-9,-97, 639, 674, 707.
——, „ , „ Porphyry *(Elvan)*, Tables XXIII.–IV.–VI.
——, „ , „ felspathic and hornblendic rocks, 162,-5, 388, 531, 534, 647—9, 737.
——, „ , „ *Itabirite* and *Jacotinga*, 211–16,–19,–21-30,–2–4, 236,-42-52,-4-74,-97-300,-13-15,-24-6,-9-30.
——, „ , „ calcareous, alternating with felspathic and hornblendic, rocks, 79, 86.
——, „ , „ sandstone, 38, 40.
——, „ , „ carboniferous slates, 605,–17.
——, „ , „ „ limestones, 617,-21,-4.

Iron, ores of, in Coal-measures, 64–8, 510.
——, „ , „ New Red Sandstone, 514—15.
——, „ , „ *Carvoeira*, 239—41.
——, „ , „ *Canga*, 217,–36,-45,–8,-98,-9, 315.
Iron-mining, in the Himalaya, 48—55.
Iron-smelting, in Brazil, 219-20,–60–2.
————, „ the Himalaya, 53—62.
————, near Lake Superior, 388—90.
Irrigation, works of, in Upper India, 43.
Itabira, the Mining district of, 214—18.
——, „ , quantities of gold obtained in, 216-17, 368.
——, „ , qualities of „ , 215.
——, „ , mode of working and description of tools used in, 217—18.
——, „ , gold extracted from mud in the streets at, 217.
——, manufacture of iron in the neighbourhood of, 218—20.
Itabira, mine of, rocks and metalliferous deposits of, 214—18.
Itabirite, derivation of the name, 172, 214.
——, composition of, 211–16,–19,–21,–4,-7,-42,-4,-8,-9,-50,-1, 287,-97,-8, 303,-13,-24,-88-9, 767.
——, structure of, 211,–14,–16,–21,–3,–5,–7,–42,-9,-50,-1,-98, 324,-9,-89, 767.
——, contains little gold, 219,-42,-5,-9.

Jackson, Dr. C. T., on the purity of copper near Lake Superior, 418.
——————, „ mode and cost of extracting copper from ..... „ ,426,-8.
——————, „ native silver of..... „ ,436.
——————, „ subterranean temperature „ ,733–4.
——————, & — Alger, Esq., on copper-ores of the Nova Scotian coal-measures, 507.
Jacotinga, derivation of the name, 214.
————, place of in the *Itabirite* formation, 214,-16,-19,-22,-3, 224,-7,-8,-9,-30,-45,-7,-50-1,-7,-9,-62-7,-71,-4,-81,-2, 313,-14,-19,-25,-6.
————, encloses *Horses* of *Itabirite* containing lines of auriferous *Jacotinga*, 251,-65, 319.
————, limited vertical and horizontal range of rich beds, 224,-7, 230,-2-4,-62,-4-7,-9,-71,-82, 325.
————, composition of, 214-15,-19,-21,-3,-7-9,-30,-3-4,-44,-5, 251,-4,-5,-6-7,-62,-4-75, 313-14,-24,-7.
————, structure of, 214,-19,-21,-3,-7,-8,-30,-46,-9,-56,-9,-60, 264-9,-70, 318-19,-29-30.
————, distribution of gold in, 215,-16,-19,-23-7,-30,-3,-4,-42, 245,-7,-57,-62-4,-6,-71,-2,-4,-7, 319,-26,-30.
————, proportions of gold in, 230,-2,-5,-55,-79,-81, 325,-7,-31.
————, „ , nature, proportion, and distribution of alloy in, 215,-36,-86, 335,-7,-8.
————, displacements of, by *cross-veins*, 226,-8,-86-7, 341.
————, temperature of mines in, 728-31,-51,-6,-7,-8,-61; Tables XXXII.—XXXVI.
Jamaica, on the copper-bearing granite of, 511.
James, Captain Richard, on submarine works at *Wheal Margery*, 599.
James, S. H., Esq., on submarine works ... at ..... *Botallack*, 599.
——————, on the proportion of tin in the vein-stone of, „ ,472.
——————, „ proceeds and profits of „ ,443; Table XIV.
——————, „ existence of eels in mine-water at „ ,717.
Jars, M. G., on the proportions of silver in Norwegian ores, 100.
————, „ „ English lead-ores, 107.

Jars, M. G., on the ores of Fahlun, 543.
Jeffery, Captain William, on the auriferous deposit of *Gongo Soco*, 255,-66,-70-3.
Jenkin, Alfred, Esq., on the proportions of metal in the silver-ores of *Herland*, 111—12.
Jenkin, Wheal, on the tin-ore of, 677.
Jennings, Captain William, on the auriferous deposit of *Gongo Soco*, 255,—66, 271–4.
———————, „ „ of *Antonio Pereira*, 304.
———————, on a land-slip at *Gongo Soco*, 350.
Jewel, Wheal (Calstock), on the silver-ore of, 116.
Jewel, Wheal (Gwennap), alleged waste of earthy black copper-ore at, 694.
———————, profits of, 451; Table XIV.
Jham, on the ferruginous conglomerate of, 39.
Jherria, on the ferruginous sandstone of, 64.
Johnson, P. N., Esq., on the proportions of silver in the lead-ore of Devonshire, 110.
———————, „ ore of *Wheal Duchy (Brothers)*, 115.
———————, analysis of *Carvoeira* from *Catta Preta*, 240.
———————, „ *Jacotinga* „ *Gongo Soco*, 267.
———————, „ auriferous native copper from

Johnson, P. N., Esq., on the qualities of gold in different rocks, 236, 332—6.
——————, his present of palladium to the Geological Society of London, 336.
Johnstone, R., Esq., M.D., on the elevation of land at Caldera by by an earthquake, 157–8.
Johnston, J. W. F., Esq., on the Geology of New Brunswick, 490.
——————, „ sandstones of „ , 501.
——————, „ slate of the Tattagouche, 495.
Joints, directions of, in granite, 3, 341,–85, 492, 511, 673-4,-80-1.
——, „ , „ gneiss, 520,—6.
——, „ , „ talcose, micaceous, and chloritic slates, 7, 12-13, 15, 18, 26, 211,-98, 301,-2, 603,-37, 651-2,-74.
——, „ , „ quartz-rocks, 30, 180.
——, „ , „ clay-slate, 26, 182–3,–6,–7,–8,–90,–1,–3,-5, 207, 317,-21,-3, 500-1,-59,-75, 674, 703; Tables II. XXIV. XXVII. XXVIII.
——, „ , „ porphyry, 651—2.
——, „ , „ hornblendic and felspathic rocks, 161,-4, 405, 648,-71.
——, „ , „ „ & limestones which alternate with them, 74, 84,-8, 124.
——, „ , „ carboniferous slate, 603,—14; Tables XX. [XXI.
——, „ , „ „ limestone, 614.
——, „ , „ the Coal-measures, 503,—6.
——, „ , „ New Red Sandstone, 515.
——, „ , „ recent sandstone, 155.
——, „ , „ rocks generally, their influence on metalliferous deposits, 474, 560, 603,-49.
——, „ , „ metalliferous deposits, 76, 84,-8, 181,-6,-7, 188,–91,–3, 207,-23,-5,-46,-50,-64, 421 433,-67,-8,-80, 543,–51–3,-69,-97, 603, 605,-80-1, 712; Tables III. VI. VIII. X. XVII. XVIII. XX. XXI. XXIII. XXIV.
——, „ , „ metalliferous deposits containing native copper, 433,-69,-80; Table XIII.
——, „ , „ „ „ gold, 181,—2, 223, 264; Tables VIII. X.
——, „ , „ „ „ silver, 76; Table III.

Joints, directions of, in metalliferous deposits containing } ores of copper, 13, 187,-8, 207, 321,—3; Table X.
——, „ , „ „ „ iron, 181, 225,–47, 264, 469.
——, „ , „ „ „ iron (auriferous), 187,—8, 207, 321, 323; Tables VI. X.
——, „ , „ „ „ molybdenum, 654.
——, „ , „ „ „ silver, 76, 88.
——, „ , „ „ fragmentary matter, 75, 225, 247.
——, „ , „ „ clay, 18, 182, 559, 648,–83.
——, „ , „ *cross-veins*, 124, 683.
——, „ , grooves (striæ), on their opposite sides, 433, 469, 552, 648,–83; Table VI.
——, „ , displacement of metalliferous deposits by, 183,
——, „ , air emitted by, 250. [301, 474, 559.
——, „ , inflammable gas emitted by, 195-6; Table VI.
José, San (Copiapò), copper-mining at, 164-5.
José, San (Chañarcillo), extent and produce of works at, 124; Tables IV. XIV.
Juan, San, on the ores of copper in sandstone at, 514.
Jukes, G. B., Esq., on the carboniferous slates of } Cork and Kerry, 602-3,-11-12

Kempston, Nicholas, Esq., on the use of a beechen *plunger* at } *Connorree*, 569.
——————————, „ wooden linings for the pumps at } „ , 570.
Kendall, John, Esq., on profits made in *Wheal Vor*, 446.
Kenmare, mining district near, on the rocks of the, 611–15.
———, „ , „ copper and lead *lodes* of the, 616-21.
———, „ , „ *cross-vein* of the, 622.
———, „ , subterranean temperature observed in the, 742-4.
Keweenaw Point, on the configuration of, 394.
——————, „ rocks of, 394-404.
——————, „ *lodes* of, 405-39.
——————, „ native copper of, 421–2,–5–36,–62–3; Tables XII. XIII.
——————, „ native silver of, 436.
——————, „ *cross-vein (Slide)* at, 439.
——————, subterranean temperature observed at, 733-4.
——————, on the erection of a *Man-engine* at the *Cliff* mine, 439-40.
——————, „ produce and profits of mines at, 440,-59; Table XIV.
——————, „ antiquities discovered at, 412-19.
Keyne, Saint, temperature of water in the well at, 749.
Keyserling, Count A. von, on the gold-mine of Berezovsk, 177.
——————————, „ detrital gold and platina of the Ural, } 175, 340; Table XXII.
——————————, „ „ , parent rock of, 343.
——————————, „ copper-ore of the Coal-measures in the Ural, 508.
Khetsaree, on the iron-mines, furnaces, and miners of, 21,–9,–57; [Table II.
Khuloagarh, on the iron-ores of, 33,—5.
Khurna, on the iron-ores of, 33,—6.
Killarney, magnetic declination at, 616.
Kinahan, G. H., Esq., on the chloritic minerals of Cork, 602.
Klaproth, M. M. H., on the argentiferous lead-ores of Cornwall, [118,-19.
Knockmahon, on the rocks of, 593, 601, 738.
————, „ organic remains at, 594—5.
————, „ *lodes* of, 594—8, 739; Table XIX.
————, „ *cross-veins* of, 598.

Knockmahon, on the submarine works at, 599—600.
————, „ subterranean temperature at, 740.
————, „ produce, costs, and profit at, 442, 601; Table XIV.
Knott, Capt. William, on the proportions of metal in the silver-ores of the *East Cornwall Silver Mines*, *Wheal Ducky*, *Wheal Brothers*, *Wheal Sisters*, *Wheal Langford*, and *Wheal Mexico* (Calstock), 115—16.
Kokcharoff, M., on a mass of detrital gold discovered at Zarevo-Alexandrofsky, Table XXII.
Kotelar, on the iron-ores and furnaces of, 29, 57.
Kumaon, on the rocks of, 1—4.
————, „ copper-mines of, 4—18.
————, „ iron- „ , 18—42.
————, „ mining-works of, 48—53.
————, „ smelting- „ „ , 53—62.
————, „ Royalties paid in, 62—3.
————, „ detrital deposits of, 42—6.
————, „ „ , streams disappear in, and reappear from beneath, them, 44.
————, on the forests of, 21.
Kurn Pryag, gold in the Aluknunda at, 4.
Kurrye, on the rocks and copper-ores of, 4.
Kurroolee, on the iron-ores of, 33—7.

Landslips, frequent at *Gongo Soco* during the rainy season, 350.
Langford, Wheal, proportions of silver in the ores of, 115,-20.
Lanivet, proportion of tin-ore in the vein-stones of, 472.
Lanreath, on the Mining district of, 699—720.
———, subterranean temperature of, 748-9.
Lapham, J. A., Esq., on the ancient copper-miners of Lake Superior, [417.
Larraona, on the early discovery of copper-ore at, 154.
Laur, M. —, on the auriferous deposits of California, 338—9.
————, „ detrital gold ..... of „ , 343.
Laws, Mining, of Brazil, 361—5.
——, „ of Chili, 148.
Lead, directions, inclinations, widths, and ingredients of deposits containing,—
——, ores of, in gneiss, 517-27.
——, „ , in quartz-rocks, 643-5.
——, „ , in clay-slate, 699-720.
——, „ , in hornblendic and felspathic rocks, 532-8, 701-2.
——, „ , in carboniferous limestone, 610-21.
——, „ , associated with gold, in Australia, 99.
——, „ , „ , in Brazil, 334,-75.
——, „ , „ , in Virginia, 376,-7.
——, „ , „ , in Wales, 640.
——, „ , associated with silver, in Australia, 99.
——, „ , „ , in Bohemia, 101.
——, „ , „ , in Chili, Table III.
——, „ , „ , in Cornwall, 111-12,-15-21, 707—14.
——, „ , „ , in Cumberland, 108—9.
——, „ , „ , in Derbyshire, 109.
——, „ , „ , in Devonshire, 109-10.
——, „ , „ , in Durham, 107-8.
——, „ , „ , in France, 103-5, 526,-37.
——, „ , „ , in Hanover, 101.
——, „ , „ , in Hungary, 100-1.
——, „ , „ , in Ireland, 105, 546,-8,-9, 621.
——, „ , „ , in the Isle of Man, 105.
——, „ , „ , in Northumberland, 107-8.
——, „ , „ , in Norway, 100.
——, „ , „ , in Sark, 121, 535-7.
——, „ , „ , in Scotland, 106, 643-5.
——, „ , „ , in Shropshire, 109.

Lead, ores of, associated with silver, in Sicily and Calabria, 102,
——, „ , „ , in Spain, 102-3.
——, „ , „ , in the United States, 99.
——, „ , „ , in Wales, 106–7, 546,–76.
——, „ , proportions of silver afforded by them at different depths, 708–10.
——, „ , condition of the silver contained in them, 121, 710.
Lead-mines, subterranean temperature in, 756,-8; Tables XXXIV. XXXV.
Lean, Messrs. Thomas and Joel, on the use of the *plunger-pole* at *Leaps* (See *Displacements.–Vertical.*) [*Crenver* and *Oatfield*, 570.
Leitaõ, M., on the proportion of silver in Spanish lead-ore, 103.
Lelivec, M., on the proportions of silver afforded by French lead-ores, 103.
Le Play, M. F., on the detrital gold of Siberia, Table XXII.
Lettsom, W. G., Esq. (& Gregg, R. H., Esq.), on the silver-ores of *Levant*, on the native silver of, 110. [Cornwall, 116,-18.
———, „ extent of submarine works at, 599.
———, „ profits at, 442; Table XIV.
Levels and *Winzes*, when and by whom substituted for *Stopes* in the mines of Cornwall, 146, 645–7.
Levy, Armand, Esq., on the iron-ores of *Antonio Pereira*, 213.
————————, „ produce of gold-mines of Brazil, 369.
Liefchild, J. R., Esq., on the inclined railways at *Wheal Friendship*,
Lignite, in the copper-bearing sandstone of Huidobro, 513. [144.

Limestones, carboniferous, composition & structure of, 613-16,-18-
————, sprinkled and veined with copper-ore, 13. [621,-2-6.
————, „ silver and silver-ore, 76—7,
————, *lodes* in, 80-124, 616-21,-23-6. [89-90.
————, *cross-veins* in, 71, 124-30, 622.
————, subterranean temperature in, 724-5,-42-4.
Lingula-flags, auriferous deposits in the, 635-42.
Lisburne mines, on the returns, expenditure, and profit of the, 459-
Liskeard, mining-districts near, 650-720,-44-9. [460.
Little Bounds, extent of submarine works at, 600.
Llama, unsuccessful attempts to naturalize the, in Chili, 141.
Lloyd, The Rev. C. A. A., on the climate of Shropshire, 750.
Lloyd, Colonel, on the mines of Chañarcillo, 148.
Lloyd, The Rev. Dr., on the climate of various localities in Ireland, 738—9, 741.
————, „ Magnetic declination at „ , 541,-75.
Lodes. (See *Metalliferous deposits*.)
Logan, Sir W. E., on the sandstones of Lake Superior, 393.
————, „ „ of New Brunswick, 502-3.
————, „ fossil flora of „ , 505.
Lonsdale, William, Esq., on the fossil flora of New Brunswick, 505.
Lory, M. Ch., on the rocks of *Chalanches*, 519.
Loss of gold during the processes of reduction at *Morro Velho*, 204-5.
Luc, J. A. De, Esq., on alternations of granite and slate at *Cook's-kitchen*, 658.
Luçencia, on the precipitation of copper at, 590,-2.
Ludcott, Wheal, on the proportions of silver and of lead in the ores of, 120, 710-11.
————, „ produce, profit, and loss at, 719.
Luke, Capt. John, on the auriferous deposits of *Agoa Quente*, 233.
————, „ „ *Gongo Soco*, 273.
Lusghanee, on the iron-ores of, 22.
Luttea Garh, on the copper-ores of, 20.
Lushington, G. T., Esq., on native-mining in the Himalaya, 51.
————, on the wages of native miners in the „ , 61.
————, on experimental works in the „ , by a Cornish Superintendent, 52.
————, on the use of pine-torches in the Himalaya, 52.

Lushington, G. T, Esq., on the scenery of the Himalaya, 16.
Luz, Senr. J. D. R. da, on the supercession of mining by agriculture, in Brazil, 370.
Lyell, Sir Charles, on the fossil flora of New Brunswick, 504—5.
Lyon, Capt. G. F., R.N., on the auriferous deposits at *Gongo Soco*, 257,-68,-9,-71,-3,-8,-84.
——————————, on a landslip at *Gongo Soco*, 350.
Lysons, The Rev. D., on the proportion of silver contained in the lead-ores of Devon and Cornwall, 110,-11,-14.

Maarum, on the iron-furnaces of, 19.
Macculloch, Dr. John, on the Geology of Sark, 530,-2.
——————————, „ mica-slate of Breadalbune, 645,-50.
——————————, „ curvatures of schistose rocks, 260.
——————————, „ relations of beds and veins to the rocks adjoining them, 187.
Machinery, manufactured in England for the mines of Brazil, 288.
Magalhães, Colonel F. L. M. de, on his mine of *Thesoureiro*, 303.
Magnesian limestone, 85, 297–8, 304.
Magnetic declination, in Brazil (Minas Geraës), 177.
——————————, in Chili (Chañarcillo), 69.
——————————, in the Channel Islands, 531.
——————————, in England (Cornwall), 673, 703.
——————————, „ , (Shropshire) 515.

Man, Isle of, proportion of silver in the lead-ore of, 105.
Man-engines, notices of, 439, 609.
Manganese, ores of, in Bengal, 65.
———, „ „ Brazil, 174, 216,-19,-23,-8,-39,-40,-3,-4, 246,-7,-62,-3,-4,-5,-9, 303,-14, 496, 728,-9.
———, „ „ France, 527.
———, „ „ the Himalaya, Table I.
———, „ „ New Brunswick, 496.
Manto de Agua, an impermeable bed of clayey limestone, 77.
Manto de Cachi, a thin bed of calcareous spar, 79.
Manto de Ossa, dimensions, composition, and structure of, 75, 82.
———, displacement of by *flucans*, 125.
Marazion district, subterranean temperature in the, 752.
Marchand & Scheerer, MM., on the specific gravity of copper after compression, 430.
Margery, Wheal, extent of underground works at, 599.
Marianna, present poverty of the gold-mines near, 368.
Marke Valley, on the rocks of, 656,-9,-61,-7-8,-71,-3,-4.
———, „ „ in confronting *(walls)* sides of the *lode* 659-60.
———, „ *lodes* of, 676,-7,-9; Table XXVI.
———, „ the population employed, machinery in use at, and produce of, 698.
———, „ subterranean temperature at, 746.
Marmato, diminution of springs consequent on clearing the surface at, 137.
———, subterranean temperature at, 770.
Marrot, M., proportion of silver in the lead-ore of France, 104.
Martius, Dr. C. F. P. von, & Spix, Dr. J. B. von, on the mountains of Minas Geraës, 178.
———, „ vegetation „ , 169.
———, „ rocks of „ , 174, 210,-11, 212, 304.
———, „ minerals of „ , 174, 305-6.
———, „ gold-mines of „ , 180,—4—5, 222-3,-38-9, 243, 303.
———, „ quality of gold in „ , 213.
———, „ iron smelt-works of „ , 212-13.

Martyn, Thomas, Esq., on the silver-ore of *Wheal Basset*, 113.
Mary Ann, Wheal, on the clay-slates and greenstones of, 700–3.
——————, „ direction, dip, width, and composition of the *lode* at, 704–14.
——————, „ brecciated and concretionary structure prevalent in portions of, 712-14.
——————, „ (seemingly) isolated masses of vein-stone which represent it, 714.
——————, „ proportions of silver extracted from the lead-ores of, ... } 120.
——————, „ „ , obtained at different depths in, 709.
——————, „ *cross-veins (flucan)* at, 715-16.
——————, „ „ , displacements of the *lode* by, 716-17.
——————, „ sulphate of lime contained in the water at, 717.
——————, „ subterranean temperature at, 748; Tables XXXIV. XXXV.
——————, „ rate at which the works have been deepened, } 748.
——————, „ population employed at, machinery in use at, produce and profits of, 718-20.
Mary, Wheal, proportion of tin-ore in the vein-stone of, 479.

Matthews, J., Esq., on the (alleged) waste of copper-ore near Tavistock, 693.
Matthey, G., Esq., on the quality of Californian gold, Table XXII.
Matrix. (See *Composition.*)
Mawe, J., Esq., on the topaz and euclase of Brazil, 300,-5.
———, „ gold-mines of ..... „ , 243, 351.
———, „ detrital gold of ..... „ , 221, 301,-42.
———, „ exportation of gold by smugglers, 365.
Mayen, Dr., on the valley of Copiapò, 140.
Meadow-mine, on the rocks and *lodes* of, 411.
Mehelchowree, on the iron-ores of, Table II.
Mendips, on fossiliferous lead-*lodes* of the, 625—6.
Mercury, on the quantity of, in use at *Morro Velho*, Table VII.
———, „ , lost at „ , Table VII.; 334,-74.
———, „ , lost in California, Table XXII.
Merionethshire, on the auriferous rocks of, 635.
———, „ copper turbaries of, 580.
Metales calidos, most plentiful at small depths, 97, 121-2.
Metales frios, „ at great „ , 97, 121-2.
Metallic minerals, dissemination of, through } granite, 175, 311,-20, 511-12, 664.
———, „ talcose rocks, 177, 210,-99, 301, 302,-3,-20, 495.
———, „ porphyry, traversing mica-slate, 654.
———, „ clay-slate, 175,-86,-96,-321.
———, „ calcareo-siliceous rocks, 249, 304, 323.
———, „ *Itabirite (Jacotinga)*, 219,—42, 249,-55.
———, „ calcareous, alternating with hornblendic, rocks, 76-7, 89-90.
———, „ coal-shales, 502-10.
———, „ sandstones, 513-15.
———, „ trappean conglomerate, 475.
———, dissemination of copper and the ores of copper, 236, 475,-95, 503-10,-11-12.
———, „ gold, 175,-7,-86,-96, 210-19,-36, 249,-55,-6,-8,-99, 300,-1,-2, 303,-4,-11,-24,-75.

Metallic minerals, dissemination of molybdenite, 654.
———————, „ silver and the ores of silver, 76–77, 89-90.
———————, „ tin-ore, 175, 664.
Metalliferous deposits;—their directions, inclinations, and widths—
———————; in Brazil, 181,-2,-3,-4,-8,-9,-90, 211,-14, 216,-17,-19,-21,-3,-7,-9,-30-5,-6,-40,-2,-5, 247,-9,-53,-9,-98–300,-1,-2,-3,-9,-10,-11, 375; Tables VI. VIII. X.
———————; in the Channel Islands, 531,—2,—3, 737; Table XVII.
———————; in Chili, 71, 81,-3, 91-3, 133,-61–2,-4-5; Table III.
———————; „ , divergent directions of, 81.
———————; in England; { Cornwall, 410, 674-5, 704-5 Tables XXIII.—XXIX. Shropshire, 515.
———————; in France, 520—1; Table XVI.
———————; „ , divergent bearings of, 520,-6.
———————; in the Himalaya, 4, 5, 7, 9, 11, 12, 14, 15, 18, 19, 20,-4,-5,-6,-8, 30,-3,-5,-6,-7,-9, 41; Tables I. II.
———————; in Ireland, 542–4,–63–4,–96, 603-4,-16, 620,-3; Tables XVIII.—XXI.

Metalliferous deposits, yielding ..... copper and its ores, 4,-5,-7, 9, 11, 12, 14, 15, 18, 161-162,-4-5,-88-90, 236, 316, 405,-6,-8,-9,-10,-11, 423,-35,-60,-3,-4,-5,-7, 468,-79-80, 513-14,-15, 542-4,-63-4,-75,-6,-96, 603-4,-16,-74-5; Tables VI. XII. XIII. XV. XXIII. XXIV. XXV. XXVI.

———————, „ ..... gold, 181,-2,-3,-8-9,-90, 211,-14,-16,-19,-21,-3, 227,-9,-30-5,-6,-40,-2, 245,-9,-54,-9,-64,-6,-7, 298, 300,-1,-2,-3,-9,-10, 311,-72,-5,-7,-9,-80, 637-638; Tables VI. VIII. X.

———————, „ the ores of iron, 19, 20,-4,-5,-6,-8, 30,-3,-5,-6,-7,-9, 41, 188-189, 211,-14,-16,-19,-21, 223,-7,-9,-35,-6,-42,-5, 247,-9,-53-4,-9,-64,-6,-7, 298, 300,-9,-89-90, 542-544,-63-4, 647; Tables I. II.

———————, „ „ of lead, 520-1,-32, 620,-43, 704-5; Tables XXVII.-XXIX.

———————, „ „ of molybdenum, 650,-4.

———————, „ „ of nickel, 520-1.

———————, „ „ of palladium, 214,-16,-49, 253-4,-9,-64,-6.

———————, „ „ of platina, 249,-53-4,-9,-64, 266.

———————, „ „ of silver, 71, 81-3, 91, 133, 188,-9,-90, 227,-9,-35, 249,-53-4, 309-10,-72, 423, 520-1,-32,-42-4, 616,-37-8, 704-5; Tables III. VI. VIII. X. XVI. XVII. XVIII. XXVII. XXVIII. XXIX.

———————, „ „ of tellurium, 376,-9-80.

———————, „ „ of tin, 674-5; Tables XXV. XXVI.

Metalliferous deposits, yielding the ores of zinc, 520-1,-63,-77, 620, 637-8,-43,-704.
——————, in granite, 674-5; Tables XXIII.—XXVI.
——————, in gneiss, 520–1.
——————, in talcose, micaceous, and chloritic rocks, 4, 5, 7, 9, 11, 19, 20,-2,-3,-6, 177, 211,-98, 300,-1,-2,-3,-9,-10,-11,-72,-5,-7,-9-80, 603–4,-52,-74-5; Tables I. X. XXV. XXVI.
——————, in quartz-rocks, 181; Table X.
——————, in clay-slate, 5, 25,-6,-8,-31, 182,-3,-8,-9, 190, 309,-10,-11,-72,-7, 542-4,-63-4,-75, 596, 674-5; Tables II. X. XXV.—XXIX.
——————, in calcareous slate, 4, 12, 35,-6,-7.
——————, in *Itabirite (Jacotinga)*, 214,-16,-19,-21,-3, 227,-9-35,-42,-5,-9,-53-4,-9,-63,-4,-6,-7, 298, 309-11; Tables VIII. X.
——————, in Hornblendic rocks, 405-10,-11,-20,-3,-60, 463,-4,-5,-7-8,-79,-80-1, 532, 647, 704-5; Tables XII. XIII. XV. XVII. XXVII. XXVIII.
——————, in Hornblendic rocks alternating with limestones, 71, 81-3, 91, 133; Table III.
——————, in Carboniferous slates, 603–4,-16; Table

Metalliferous deposits, which conform to the cleavage of schistose rocks, 4, 5, 7, 8 9, 11, 19, 20,-1,-5,-6,-8,-30-32,-3,-5,-6,-7,-41,-82, 161,-77,-80,-2,-3,-4, 187-8, 211,-14,-16,-19,-21,-3,-7,-9,-30,-6, 242,-5,-7,-9,-59,-66,-7,-98, 300,-1,-2,-3,-10, 372,-5,-6,-9, 463,-4,-5,-7,-79,-80, 542,-53, 554,-63,-75, 602,-20,-37,-47,-52, 737; Tables II. VI. VIII. X. XV. XVIII. XXI.

——————, which conform to the cleavage of schistose rocks in direction, but are more highly inclined, 564, 604; Tables XVIII. XX.

——————, " to the joints of rocks, 14, 15, 22, 74, 81,-5, 164,-83,-7-188, 223,-64,-99, 301,-2, 315, 603,—18,—24,—74; Tables I. III. VI. VIII. X. XXIII.—XXVI.

——————, " to the cleavage in some, but with the joints in other, places, 187-8, 223,-64,-98-299, 301,—2; Tables VI. VIII. X.

——————, " to neither cleavage nor joint, 81, 405,-9,-10,-11,-22,-60, 515,-20-1,-32,-54,-64,-96, 602,-4, 704; Tables XII. XIII. XVI. XVII., XIX. XX. XXVII.-IX.

——————, " to the joints, sometimes dip contrariwise to the cleavage;-yet sometimes dip towards neighbouring bodies of granite; 674-5.

——————, bodies *(shoots)* of metals, ores, and vein-stones in them, which conform, in endlong dip, to the *(ripples)* flexures of slates, to the inclinations of different strata on the opposite sides of joints, and to the slope of neighbouring granite, 26, 32, 122, 207,-15,-16, 224,-34,-59,-63,-4,-6,-7,-71, 323,-6, 439, 468, 535,-7,-78,-94,-7,-8, 608.

Metalliferous deposits, their richest parts are the most highly inclined, 82, 189, 270,-81, 310, 604, 706.
——————, the higher inclinations often consequent on deflection (distension) of the lower *(foot-wall)* sides, 82, 433.
——————, „ sometimes on irregularities of the upper *(hanging-wall)* sides, 83-4.
——————, enriched at their union with *(branches)* veins, 83, 91,-2, 420, 554,-7,-66-7, 607.
——————, „ at their intersections by joints, 14-16.
——————, the richer portions of parallel ones often confront, 15-16, 224,-64,-6,-7,-70, 323, 326,-30.
——————, „ of some confront the poorer portions of other, 264, 607-8.
——————, „ of divergent ones sometimes occur on the same meridian, 123.
——————, bands of barren rock, sometimes alternate with productive vein-stones and parallel sheets of native metal, 272,-3, 326, 476, 477.
——————, always partake the nature of the adjacent

Metalliferous deposits, often enclose *(horses)* masses of the contiguous rocks, 20, 84, 181,-90,-1,-4, 251,-65, 312,-17,-19,-73,-8,-81, 420,-4,-9,-61,-3, 480, 551,-5,-64,-8,-76,-96, 605,-24,-48, 712.

——————, relations between them, the contiguous *(Country)* formations, and the included *(horses)* masses of rock, 190,-1,-3-4, 251, 265, 313,-18-19,-78,-81, 424-5,-61, 551, 564, 605-6,-24,-48, 712.

——————, the shallower parts of, abound in earthy brown iron-ore, 10, 29, 162,-5,-77,-83, 246,-62, 299, 302,-3,-12,-14,-73-4,-5,-7,-81, 515, 525,-34,-45-6,-7,-65,-77,-97, 605,-17,-24, 639,-53,-76,-7,-8, 706,-10; Tables III. VI.

——————, general characters of their several vein-stones. (See *Composition.*)

——————, bounded by joints, 85, 161,-4,-81,-7, 207,-23, 264,-99, 301,-2, 464,-7, 515, 604,-16,-18, 620,-49,-80, 714.

——————, traversed longitudinally, by joints, 26, 76, 85, 161,-81, 223, 302, 425,-33,-8, 461,-8,-80,-1,-3, 515,-69,-97, 618,-24,-80.

——————, „ obliquely, by joints, 76, 181, 302, 468,-74,-80, 575.

——————, „ transversely, by joints, 181,-7, 299, 480, 559,-78.

——————, relations of joints which traverse them to joints in the neighbouring *(Country)* rocks, 13, 26, 83, 181,-3, 223,-64,-99, 301-2,-17, 405, 514,-60,-96, 603-4,-80, 707,-14.

——————, joints of, filled with *detritus*, 75, 225, 469.

——————, „ , filled and faced with } clay, 13, 39, 182, 469, 559.

——————, „ , „ metals and ores, 13, 39, 76, 181,-2, 223,-5,-8, 246,-64,-9,-80,-1,-3, 654.

——————, the sides of joints in them are often (divergently) scored, when faced with metals, ores, and clay, 13, 207, 378, 433,-69, 552, 648,-54.

——————, laminated structure common to them and to the contiguous rocks, 85.

Metalliferous deposits, of schistose structure, 214,-23,-8,-9,-37,-46, 254,-7,-9,-62,-5,-9, 269,-98, 300,-1,-2, 311,-14,-18,-19, 551-2,-3,-64,-8-9, 575.

———————, „ , often display (divergently) striated faces of unctuous clay, 552.

———————, concretionary structure of, 182,-4, 318.

———————, cavernous structure of, 77, 89, 195, 225, 312, 377, 422,-31, 515, 625,-81, 707,-13.

———————, cavities *(vughs)* in them, sprinkled with various metals and ores, 77, 90, 195, 225, 246, 312,-77, 431, 515, 625,-81.

———————, relations between their hardness and produce (of gold) at different depths, ... } in clay-slate, 199—205, 329,-31; Tables VII. X. XXII.

———————, „ in *Jacotinga*, 232—234,-69-70,-83-4, 324-7,-9,-31; Table X.

———————, relations between their hardness and their produce (of native copper), at different depths, in hornblendic (trap) rocks, 326.

———————, proportions of native copper in, 421,-34-6, 470-1.

Metalliferous deposits, proportions of silver and silver-ore in, 76, 90–121,–53, 206,-36,-86, 334-335,-8,-9,-40,-73–374,–8, 437-8, 522-4,-35-6,-45, 546,–9,–66,–8, 617,—32,—42, 708–11; Tables VII. X. XXII.
———————, " " , at different depths, 206,–86, 338–9, 708—9; Tables VII. X. XXII.
———————, " of tin-ore in, 472-3, 693.
———————, intersections and displacements of, by other metalliferous deposits, 92, 127,-8, 493, 538.
———————, " , by *cross-veins*, 127,—9, 225,-87, 341, 439,–74, 503,-15,-27,-58,-75,-98-599, 608,-22,-44,-83-5, 716-17.
———————, " , by rocks, 176,-92-4, 318.
———————, " , by joints, 183, 341, 474, 559,-75.
———————, subterranean temperature in and near, 723-84.
———————, issue of inflammable gas from crevices in, 195-6.
———————, (Detrital) of copper near Lake Superior, 484-5.
———————, " of gold in Australia, 343,-56,-9; Table XXII.
———————, " " in Banca, 631.
———————, " " in Bolivia, 360.
———————, " " in Brazil, 283, 342-70.
———————, " " in California, 343; Table XXII.
———————, " " in Canada, 384.
———————, " " in Chili, 345,-60.
———————, " " in India, 3-4, 46-7.
———————, " " in Ireland, 627-34.
———————, " " in New Granada, 360.
———————, " " in Nova Scotia, Table XXII.
———————, " " in the Rhine, 348,-51–2, 356,-8,-60; Table XXII.

Metalliferous deposits (Detrital), of gold in Siberia, 175, 342,-3,-6, 348,-60; Table XXII.
——————, " " in the United States, 384.
——————, " " , Ancient *detritus*, 283, 342-5,-6,-8.
——————, " " , proportions of metal extracted from, 346,—8. 358; Table XXII.
——————, " " , quality of metal extracted superior to that of mine-gold, 359-60.
——————, " " , crystals of metal extracted from, 356,-9, 632.
——————, " " , traced to the parent formations, 175, 343,-59-60.
——————, " " , cost of extraction, 346,-8, 358; Table XXII.
——————, (Detrital) of gold, Recent *detritus*, } 46, 346-8,-51-2,-9.
——————, " , crystals of gold in, 356,-8.
——————, " , shaped implements and ornaments mixed with, 344-5.
——————, " , an ancient Indian village imbedded in, 384.
grains of gold swallowed

Meuse, the stream of the, affected by the condition of the woods at its source, 138.
Mexico, proportion of metal in the silver-ores of, 98,-9.
———, weight of ore brought out of the mines in, by labourers, 147.
Mexico, Wheal (Calstock), proportions of metal in the silver-ores of, 115.
Mexico, Wheal (Cubert), on the native silver and silver-ore of, 110.
Mica, an ingredient of the rocks, 2, 3, 4, 29, 30, 64, 171,-2,-4,-7, 210,-11, 376,-9,-86,-7,-92, 491, 503, 511, 613,-43,-50,-62,-3,-7,-70.
——, „ „ metalliferous deposits, 511,-24, 675,
Michell, Edmund, Esq., on the profit made at *Carnon-Stream*, 452.
Michell, Edward, Esq., on the proportions of metal in the silver-ores of *Herland*, 112.
————————, „ silver in the lead-ores of Menheniot, 708-9.
————————, on the produce and profits of *East Wheal Rose*, 454.
Michell, Mr. Francis (of Redruth), on the introduction of the *plunger-pole* at *Ale and Cakes*, 570.
Michell, Capt. H., his suggestion of the use of mine-water for preventing dry-rot, 570.
Michell, James, Esq., on the proportions of silver in Spanish lead-ores, 102.
Michell, John, Esq., on the native silver and silver-ores of Cornwall and Devon, 112,-16,-18.
————————, „ argentiferous lead-ore of *Wheal Rose*, 119.
————————, „ discovery of copper-ore in Cornwall, 689,-91.
————————, „ platina associated with stream tin-ore from Australia, 286.
Miguel, Corrego de Saõ, on the metalliferous deposit of, 242.
————————, „ iron-smelting works of, 242.
————————, „ discovery of diamonds at, 242.
Miller, Major W., on the detrital gold of Virginia, 384.
Miller, Dr. W. A., on crystallization from saturated solutions, 713.
————————, analysis of mine-water from the *Clifford* mines, [586.
Mine-gold, its inferiority to detrital gold, 359,-60.

Mine-tin-ore, its inferiority to detrital tin-ore, 359, 472.
Miners, in Australia, earnings of, on quartz-formations, Table XXII.
——, „ , „ , on detrital deposits, Table XXII.
——, in Brazil, European (in mines worked by British Companies), earnings of, Table XXII.
——, „ , Native („ by Brazilian proprietors), modes of labour, 217–18,-21-2,-99.
——, „ , „ (in the beds of rivers in search of detrital gold), modes of labour and earnings of, 356-8.
——, „ , Slave, (in mines wrought by both native and foreign proprietors), modes of labour and earnings of, 217–18, 221-2,-92,-3,-9, 301.
——, „ , „ , (in mines wrought by both native and foreign proprietors), hire of, 382.
——, in Chili, European (in mines owned by native proprietors), Table V.
——. „ , Native (in mines owned by native proprietors), nature of labour, 146-7,-51-2.
——, „ , „ (in mines owned by native proprietors), amount of earnings, Table V.

Mining, early system of, in Germany, 646.
———, „ mode of, in Cornwall, 146, 448, 645-6.
———, „ „ , in Anglesea, 578.
———, „ , for copper in Cornwall, 686-94.
———, „ , „ in Chili, 154.
———, adoption of the German system in Cornwall, 146, 645-7.
———, substitution of tram-waggons for wheel-barrows in, 144.
———, present modes of raising ores to the surface in, 142-4, 609, [668-9.
———, „ of ventilation in, 219-20.
———, „ of, and implements used by native workmen, ... } in Brazil, 217-18, 221-222,-99.
———, „ , „ , in Chili, 142-8.
———, „ , „ , in the Himalaya, 48-52.
———, „ of using fire for expediting operations in, [51-2.
———, ancient, in (the Mendips) Somersetshire, 625.
———, „ , near Lake Superior, 412-19.
Mining-works, rate at which they have been deepened, } in Brazil, Tables VII. IX.
———————, „ , in Cornwall, 448, 748,-64-5.
———————, „ , near Lake Superior, 439-40.
———————, submarine, extent of, 534,-9,-94,-9-600,-10.
———————, precipitation of copper from water entering, 562,-9-592; Table XVIII.[a]
———————, growth of fish in streams issuing from, 354-5, 717,-31.
———————, vegetation ... in „ , 585,-8, 686.
———————, produce and profits of, 95-6, 123-4,-79, 208,-16,-17, 235,-47,-74-7,-89, 383, 440-59, 601,-41,-4,-94-5, 698, 720; Tables IV. VII. IX. XIV. XXII.
Mining-laws, 148, 361-5.
Minnesota mine, on the rocks of, 475.
———————, „ *lodes* of, 475-6.
———————, „ copper-bearing conglomerate of, 476-7.
———————, „ produce and profits of, 459; Table XIV.
Mitchell, John, Esq., analysis of auriferous ore from *Grasty*, 374.
Mohs, H. Frederick, on the production of Atacamite, 162.
Moissenet, M. L., on the proportions of different ores in the *lodes* of Cornwall and Devon, 693.
———————, „ use of tram-waggons in mines, 669.
———————, „ produce and profits of the *Lisburne* mines, 460.

Molybdenum, ore of, in Breadalbane, 650-4.
——————, „ , in Leicestershire, 654.
——————, „ , in Norway, 546.
——————, „ , in Australia, 654.
Mona mine, on the rocks, vein-stones, and ores of the, 574-8.
————, „ treatment to which pyritic ores are subjected at the, 578–9.
————, „ precipitation of copper from mine-water at the, 581-4; Table XVIII.[a]
————, „ quantities of ochre obtained „ , 583-4.
————, „ „ of rain at the, 582.
Monk Wearmouth, subterranean temperature at, 753.
Monlevade, M. A. J. de, on the iron-ores and smelting-works of Monlevade, 171, 219.
——————————, „ differences in the qualities of charcoal from different woods, 219.
Monte Amargo, on the recent sandstone of, 155.
Montgomery, Dr. J. B., analysis of water in the river of Copiapò, 140.
——————, on the identity of *diatoms*, in the present strand, and in the raised beaches, near Caldera, 160.
Moore, C., Esq., on a fossiliferous lead-*lode* at Charter House Warren, 625,-6.
Morcom, M., Esq., on the rate of blasting vein-stones at) 200

Morro Velho, on the rocks of, transitions between them and metalliferous deposits, 192,-3,-4, 207, 313.
———, the metalliferous deposits of; their directions, coincide sometimes with the cleavage, sometimes with the joints, but often with neither, 187-8, 90, 207, 310; Tables VI. X.
———, " ; their dip and width, 188-92, 311; Tables V. X.
———, " ; bodies *(shoots)* of the productive portions in, coincident in endlong dip with structural dispositions of rocks, 206-7, 323,-6.
———, " ; comparative hardness of, at different depths, 199; Tables VII. XXII.
———, " ; ingredients, earthy, 190,-4,-6, 202, 312, 313,—17,—21—2; Table VI.
———, " ; " , isolated masses of slate imbedded in, 190, 194, 312,-17,-28.
———; " ; " , portions conforming to the joints or oblique to the cleavage, partially or entirely severed, for short distances, by certain beds, 192,-3-4, 318.
———, " ; " , uniformity of cleavage in the *(Country)* walls, imbedded masses, and severing beds, 193-4, 318.
———, " ; ingredients, metallic, 194-7, 312,-18,-21-322; Table VII.
———; " ; " , proportions of gold contained in, 197,-8, 204-5; Tables VI.[a] VII.
———; " ; " , proportions of gold extracted from, 197, 198, 201,-3,-4,-5, 312; Tables VI.[a] VII. X. XXII.

Morro Velho, the metalliferous deposits of; ingredients, metallic, proportions of gold extracted from ores obtained at different depths, 201,—3,—5, 331; Tables VII. X. XXII.

———, " ; " , proportions of gold extracted from ores of different hardness, 199, 201,—3,—6; Tables VII. XXII.

———, " ; " , comparison between the proportions of gold contained in and extracted from the vein-stone, 198, 204, 205; Tables VI.[a] VII.

———, " ; " , analysis of gold, 334, 374.

———, " ; " , proportions of silver alloyed with gold, at different depths, 206, 332; Table X.

———, " ; " , quality of gold obtained at different depths, 205,-6, 375.

Morro Velho, the metalliferous deposits of; areas of *cured hides*, and of baize, over which the *stamped*-ore is passed, 203 ; Table VII.
———, „ ; quantities of amalgamable ore collected by each series of *hides* and baize, Table VII.
———, „ ; „ of ore escaping the *hides* and baize, but afterwards collected and ground in *arrastres*, 203, 355 ; Table VII.
——— vein-stone, extent of granulation by *stamping*, Table VII.
———, quantity of mercury used, and time required for amalgamating the *stamped* ore, Table VII.
———, „ lost during amalgamation, Tables VII. XXII.
———, costs of *(dressing)* cleaning the *stamped* ore, Table VI.[a]
———, „ , total, of extracting gold and making it ready for the market, 327.
———, issue of inflammable gas from crevices in the vein-stones, 195 ; Table VI.
———, climate of, 349,-52, 726.
———, subterranean temperature at, 726-7,-56,-8,-9,-60,-1,-2.
———, force employed at, 367,-75 ; Table VII.
———, wages of European miners at, Table XXII.
———, produce, expenditure, and profit at, 208-9; Tables VII. XIV. XXII.
———, extent of water-courses, and injuries done them by ants, 350; Table XXII,
———, fish thrive in water holding pyritic ore in suspension, near, 355.
Morro, Venda do, iron-furnaces near the, 247.
Moseley, W. M., Esq., produce, expenditure, and profits at the *Garnett and Moseley* mines, 382-3.
———, on the hire and food of slaves in Virginia, 382.
Mougeotia, the, flourishes in water which yields a precipitate of copper, 585,-8.

Mouillelonge, subterranean temperature in the coal-mine of, 753.
Mulberry Hill, proportion of tin-ore in the vein-stone of, 472.
Mules (and horses), their fondness for water holding iron-ore in suspension, 354.
Mungla Lekh, on the iron-ores of, 26.
Murchison, Sir R. I., Bart., on the copper-bearing sandstones of Salop, 514,-15,-16.
———————, (Verneuil, M. E. de, & Keyserling, Count A. von), on the auriferous Beresite of Siberia, 172.
———————, on the proportion of gold obtained at Berezovsk, 177-8.
———————, „ gold and platinum of Siberia, 340.
———————, „ detrital gold ..... „ , 175, 343.
———————, „ „ , a large mass *(Nugget)* of, Table XXII.
———————, „ copper-bearing coal-measures of Siberia, 508-9.
——————— (& Geikie, A., Esq., on the slates of Breadalbane, 646.
Murray, J. J., Esq., on the effects of an earthquake at Caldera, 158.
Music, Wheal, area of open mining-works at, 576, 665.

Nettle, W. G., Esq., on the produce costs, and profits of *Wheal Mary Ann*, 719,-20.
New Brunswick, on the granite of, 490-2.
——————, „ metalliferous slates of, 495-7,-8-501.
——————, „ greenstones of, 496-8.
——————, „ conglomerates and sandstones of, 501-2.
——————, „ copper-bearing shales of, 503-10.
——————, „ fossil flora of, 503-10.
——————, „ auriferous detritus of, 498, 500.
New Granada, on the proportion of silver in the ore of, 98.
——————, „ disappearance of springs from cleared ground in, 137–8.
——————, „ temperature at small depths in, 768–70.
Newiansk, proportions of alloy in the gold of, 335.
New Red Sandstone, deposits of copper-ore in, 515, 750.
——————, subterranean temperature of the, 750.
Nichol, Prof., on the rocks of Breadalbane, 646.
Nicholas, Capt. J., on the submarine works of *Levant*, 599.
Nicholls, Capt. J. on the proportions of tin-ore in the vein-stones of the *Prosper* mines, 472.
Nickel, ores of, at *Chalanches*, 526.
——, „ in New Brunswick (?) 503.
——, „ at Pajonales, 121.
Ninness, Mr. J., on the precipitation of copper from the water of the Gwennap adit, 587.
Noakes, G., Esq., on the produce, profit, and loss at *Wheal Vor*, 446.
Noises occasioned by moving-sand near Copiapò, 154.
North American mine, on the rocks and *lodes* of, 419-22.
—————— „ , „ disposition of (native) copper in the, 420-2,-31.
—————— „ , „ subterranean temperature at the, 734.
North Downs, on the silver-ore of, 114.
Northumberland, proportions of silver in the lead-ores of, 108.
North-West mine, on the expense of extracting (native) copper at the, 426.
Norway, on the metalliferous deposits of, 546.
——, proportions of silver in the ores of, 100.
Nova Scotia, on the copper-bearing coal-shales of, 507-8.
——————, statistics of gold-mining in, Table XXII.
Nutoa Kanh, on the iron-ores of, 22; Table I.

Oak, forests of, in the Himalaya, 55.
——, rejected by charcoal-burners in the Himalaya, 55.
Oates, G., Esq., on the influence of *cross-veins* on the *sulphur-course* of Wicklow, 558-9.
Ochre, lining crevices in the *Itabirite* at *Agoa Quente*, 225.
——, quantities of, deposited in the precipitation-works at *Mona*, 583-4.
Odernheimer, G., Esq., on the mica-slate of Breadalbane, 645,-50.
————————, „ greenstones and porphyries of „ , 650.
————————, „ *lodes* of ..... „ , 652.
Oil, mineral, of *Borriga* and *Expectativa*, 516.
Oldham, Dr. T., on subterranean temperature at *Knockmahon*, 740.
Oliveira, Col. M. F. de, gold-mines wrought by, in Brazil, 237.
Oliveira, Capt. M. J. F. de, on the gold of *Catta Preta*, 237.
Ollivant, S., Esq., on the gold produced in Minas Geraës, 369.
O'Niel, C., Esq., on the gold of Merionethshire, 641.
Oojowlee, on the iron-ores of, 33,-6.
Open mining-works, 222,-34,-7,-56, 576, 665.
Ores. (See *Antimony*, *Arsenic*, *Bismuth*, *Chromium*, *Cobalt*, *Copper*, *Gold*, *Iron*, *Lead*, *Manganese*, *Molybdenum*, *Nickel*, *Palladium*, *Platina*, *Silver*, *Tellurium*, *Tin*, *Titanium*, *Zinc*.
Organic remains of the Carboniferous system, 613-14,-23.

Ovoca, on the earnings of miners in the vale of, 562.
———, „ precipitation of copper from mine-water } „ , 570-89.
———, „ auriferous pyrites of *Connorree* and *Ballymurtagh*, 549-59.

Pache, M., on the proportions of silver and gold in the lead-ores of Hungary, 100.
Paciencia, on the association of antimony-glance and tellurium with gold at, 180.
Pacific, shells existing in the, found also in raised-beaches near, Caldera, 156.
Pahlee (in Ramgurh), on the specular-iron of, 25.
Pahlee (in Kalee Kumaon), on the brown iron-ore of, 26.
Paillette, M., on the argentiferous lead-ores of Sicily and Calabria, 102.
———, „ proportions of silver in Spanish lead-ores, 102.
Pajonales, on the ores of cobalt, nickel, and silver at, 121.
Palladium, associated with the gold of *Candonga*, 175.
———, „ *Santa Anna* and *Itabira*, 215.
———, „ *Gongo Soco*, 286, 337,-8,-40.
———, „ , in granite, 175.
———, „ , in *Itabirite (Jacotinga)*, } 215,-86,
———, „ , „ , proportions of at different depths, 286, 338,-40.
Parallelism of some deposits which yield silver-ore with others which contain clay only, 81.
———of masses of silver-ore in deposits having different directions, 123.
———of gold-deposits to the ranges of mountains in which they occur, 176, 221,-45,-8, 304,-10,-11 ; Table X.
———of the *Sulphur-course* near Ovoca to the cleavage of the adjoining rocks, 553.
——— „ great body of pyritous copper-ore in Anglesea } „ , 575.
——— „ rich *bunches* of copper-ore on different *lodes* near Kenmare, 618.
——— „ orey parts of some with the barren portions of other *lodes*, 607-8.
Paraöpéba, schorlaceous sands of the, contain chrome-ore and manganese. 174.

Par Consolidated mines, proportions of tin-ore in the vein-stones of, [472.
Park mine, proportions of silver in the lead-ores of, 110.
Parys mine, rocks of the, 574.
———, metalliferous deposits of the, 575–8.
———, *cross-veins* of, 575,
———, analysis of the *(blue-stone)* ore of, 546,-77.
———, treatment of pyritic copper-ore at, 578-9.
———, drainage of the, 580.
———, precipitation of copper from mine-water at the, 580-1.
———, copper-turf of the, 580.
Pasco (Peru), proportions of silver in the ores of, 98.
Pascoe, Capt. H., on the *lodes* of *Bearhaven*, 608.
Patol, on the iron-ores of, 33,-7.
Pattinson, H. L., Esq., on the proportions of silver in the lead-ores of England rnd Wales, 105,-7,-9,-19.
Paunchmaulee, on the clay iron-stone of, 66.
Peach, C. W., Esq., on fossiliferous rocks near Liskeard, 700.
Pebbles, beds of, far above existing streams, 45.
Pedro, San, gold imbedded in copper-glance at, 378.
Peever, Wheal, displacements of *lodes* at, 226.
Peixoto, Senr. J. de Souza, employment of slaves by, 301.
Pengilly, Capt. T., on the auriferous deposits } of *Gongo Soco*, 250,-7,-60,-3, 266,-8,-72,-4.
———, ... of *Agua Quente*, 233.

Percy, Dr. J., on the structure and specific gravity of, } electrotype copper when fused, 429.
———, „ absorption of oxygen by melted copper, 431.
———, „ treatment of copper-ores at Agordo, 579.
Periçicàba, on detrital-gold from the, 359.
Perley, M., Esq., on the rocks and ores of New Brunswick, 490,-6, 506.
Pernollet, M., on the proportions of silver in Spanish lead-ores, 102.
———, „ „ in the lead-ores of Brittany, 104.
———, „ relative positions of silver and „ in „, 537.
Persberg, on the formation of ice underground at, 479.
Pertenencias (mining concessions), numbers of in Chañarcillo, 149, 150.
Petherick, J., Esq., on the precipitation of copper at *Cobre* (Cuba), 591.
Petherick, W., Esq. (of Lake Superior), on the large *stamp-heads* } in use at Lake Superior, 426.
———, „ , „ , work accomplished by them, 426.
———, „ , on the cost of extracting native copper from its matrix, 426.
Petherick, W., Esq. (of St. Austell), on the amount of dues *(Royalties)*, paid at *Crennis*, 456.
Petroleum, issue of, from the copper-bearing sandstone of Huidobro, [516.
Pewabic, on the costs and profits at, 459; Table XIV.
Phillips, Mr. H., on the produce and profits of *Tresavean*, 451; Table XIV.
Phillips, Prof. J., on the carboniferous limestone of Yorkshire, 625.
———, „ wrinkled structure of rocks, 259.
———, „ positions of displaced strata on opposite sides of the displacing vein, 227, 660.
———, „ subterranean temperature, 723,-53.
Phillips, J. A., Esq., on the proportion of silver in the lead ore of Australia, } 99.
———, „ „ gold „ , 99.
———, „ production of „ in California, Table XXII.
———, „ „ „ in Nova Scotia, Table XXII.
——— (& Darlington, J., Esq.), on the produce and profits of mines, 459; Table XIV.

Phillips, W., Esq., on the granite and slate of Tincroft, 658.
——————, „ alleged waste of copper-ore in Cornwall, 690-2.
——————, „ silver-ores of Cornwall, 111,-12,-13,-16,
——————, „ stream-tin-ore „ , 359. [118.
——————, birth and death of, 691.
Phœnix mines, rocks of the, 656,-69.
——————, „ , on opposite sides of the *lode* at the, 657, 669.
——————, „ , metalliferous deposit of the, 676,-8,-9; Table XXX.
——————, „ , subterranean temperature in the, 746.
——————, produce of, people employed at, and machinery at work on the, 698.
Pick and gad, dexterity of Cornish miners in using the, 152.
Piedade, on the structure of the mountain, 298.
Pike, R. H., Esq., on the proportion of tin-ore in the vein-stones of the *Carn Brea* mines, 472.
——————, „ produce and profits of the „ , 448,
Pindur, on the auriferous sands of the, 4, 46. [459; Table XIV.
Pinnock, Saint, on the rocks of, 99.
——————, „ metalliferous deposit of, 704-12.
——————, „ proportions of silver in the lead-ore of, 120, 709.
——————, „ produce of, people employed, and machinery

Plunger-pole, notice of its early use in the mines of Gwennap, 570.
———, wooden, used at *Connorree*, in Wicklow, 569.
Plymouth, on the temperature of, 745,-9.
Poder, a name anciently given, in Cornwall, to certain ores of copper and (?) of iron, 689.
Pokree, on the rocks and copper-ores of, 6.
Polberro, on the produce of, 453.
———, „ proportions of tin-ore in the vein-stones of, 202, 472.
———, „ rate at which the vein-stones are blasted, 200.
Poldice, proportions of tin-ore in the vein-stones of, 472.
———, loss during former operations at, 452.
Polgooth, profit yielded by early works at, 454.
Polkinghorne, W., Esq., on the proportions of tin-ore in the vein-stones of *Cuddra & Par Consolidated* mines, 472.
Polwhele, The Rev. R., on the proportions of silver in Devonshire lead-ore, 109.
———, „ silver-ores of Cornwall, 111,-14.
Pontalba, Baron, on the proportions of pure copper in the native metal of Lake Superior, 471,-3.
Pontes, Senr. M. J. P. da Silva, on the productive gold-mines of *Itabira*, 216.
———, on the quality of the gold afforded by „ „, 215,-16, 332.
———, on the proportions of palladium in „ „, 215.
———, on the theft of gold by workmen at „ „, 216.
Pool, Wheal, on the argentiferous lead-ore of, 118.
Pooley, Capt. E., on the proportion of tin-ore in the vein-stone of *Trelyon*, 472.
Porphyry, felspathic, of New Brunswick, 491.
———, „ , of Breadalbane, 650-1.
———, „ , of Caradon, 660-1,-70-1.
———, „ , of Pra, 651.
———, stanniferous, of Geyserberg, 665-6.
Portage Lake, on the sandstones of, 391-2.
Potosi, on the proportion of silver in the ores of, 98.
Potstone of Brazil, on the, 173.
Powder, charges of, used for blasting in different mines, 200-1.

Pra, on the felspathic porphyry *(Elvan)* of, 651.
Praia (margin of the river) auriferous sand collected on, at *Morro Velho*, 355.
Prideaux, Capt. S., on the auriferous deposits of *Gongo Soco*, 257,
———————, on a landslip ..... at „ , 350.
Prince, Capt. J., on the rocks and vein-stones of Sark, 532,-3,-4.
———————, „ lead-ores ..... „ , 121, 536-7.
———————, „ silver and silver-ores „ , 121, 536-7.
Precipitation of copper from mine-water in Anglesea, 580–2,–92; Table XVIII.[a]
——————— „ in Cornwall, 385-9,-92.
——————— „ in Cuba, 590-1,-2.
——————— „ in Devon, 584-5,-92.
——————— „ in Spain, 589-91,-2.
——————— „ in Wicklow, 562-87,-92.
——————— „ , more rapid in warm, than in cold, weather, 571.
——————— „ , „ in running, than in still, water, 571.
——————— „ , quality of the precipitate affected by the nature of the precipitant, 588.
——————— „ , dues *(Royalties)* paid on,

Proportions of gold, in silver and silver-ores, 100,-1, 550.
————, „ , in copper and copper-ores, 237, 378.
————, „ , in different (Brazilian) rocks, 369.
————, „ , in detrital matter, 345,-6,-8,-58.
————, of lead and lead-ores, in vein-stones, 693.
————, „ in gold, 334,-74,
————, of palladium, in gold, 286, 338,-40 ; Table X.
————, „ , at different depths, 286, 338,-40; Table X.
————, of platina, in gold, 286, 338,-40; Table X.
————, „ , „ , at different depths, 286, 338,-40; [Table X.
————, „ , in detrital gold, 360.
————, of silver, in vein-stones, 91–3,–5–6,–7,-8-9, 100,-1,-2, 104,-12,-13,-14,-15,-16,-17,-18, 121, 437, 523-4,-36,-68, 711.
————, „ , in copper-ore, 378.
————, „ , in lead and lead-ores, 99, 100,-1,-2,-3,-4,-5, 106–10,–18,–19,-20, 121, 536, 708-9, 11.
————, „ , „ , at different depths, 708-9.
————, „ , in mine-gold, ... „ , 206, 286, 335,-8,-40,-74 ; Table VII.
————, „ , in detrital gold, 360.
————, of tellurium, in gold, 336.
————, of tin-ore, in vein-stones, 202, 472,-3, 693.
————, „ , in detrital matter, 630.
Prosper United mines, proportions of tin-ore in the vein-stones of, [472.
Providence mines, rocks of the, 659.
————, proportions of tin-ore in the vein-stones of the, 472.
————, produce and profits of the, 444 ; Table XIV.
Providence, Wheal (Tremayne, Wheal), on the argentiferous lead-ore of, 118.
Pryce, Dr. W., on the composition of *lodes*, 676,-8.
————, „ „ , when productive, 653.
————, „ proportion of copper-ore in *lodes*, 693.
————, on early copper-mining in Cornwall, 688-90,-1.
————, „ loss of copper-ore owing to careless treatment, 693.
————, „ argentiferous lead-ores of Cornwall, 118,-19.
————, „ stream-tin-ore ..... „ , 486.
————, „ precipitation of copper from mine-water „ , 585.

Pryce, Dr. W., on salt water which enters submarine mines, 539.
Pumps, in the mines of Brazil, sometimes worked with *rag and chain*, 345.
———, „ „ , iron-work of, manufactured } in England, 288.
———, „ „ , wood-work of, manufactured } on the spot, 288.
———, „ Cornwall, comparison of calculated, with actual efficiency of, 570.
Punaar, on the graphitic clay-slate of, 41.
Puntas, Tres, on the production of silver at, 153.
Puracé, on the climate of, 770.
Purturburà, on the iron-ore of, 24; Table I.
Pyrites. (See *Ores of Copper* and *Ores of Iron.*)

Quality of gold, in Bolivia, 360.
——— „ , in Brazil, 205-6,-14,-15,-36,-7,-85,-99, 317, 32-3, 334,-8,-58; Tables VII. IX. X.
——— „ , in California, 339; Table XXII.
——— „ , in Canada, 384.
——— „ , in Ireland, 633.
——— „ , in New Granada, 360.
——— „ , in Siberia, 335,-60.
——— „ , in Virginia, 374,-83.
——— „ , in Wales, 642.
——— „ , in different rocks, 332,-4-5; Table X.
——— „ , in different parts of the same formation, } 205-6,-85-6, 332-334; Tables VII. IX.
——— „ , at different depths „ , 205-6,-85-6, 332-334; Tables VII. IX.
——— „ , in large masses, inferior to the quality of smaller bodies in other localities, 332-3.
——— „ , different in crystals of different forms, 335-6.
——— „ , in detrital deposits superior to that of gold in rock-formations, 359-60.
——— of silver and silver-ore in the several limestones of Chañarcillo, 98-121.
——— of silver-ore and of lead-ore in different parts of *Sark's Hope*, 535.

Quartz, an ingredient of rocks, 2, 3, 4, 11, 12, 18, 21,-6, 30,-1,-5-36,-9, 64-5, 78,-9, 85, 161,-4,-71,-2,-4,-7, 178,-80,-5, 211,-14,-17,-19,-21,-4,-5,-39, 244,-5,-7,-8,-50,-5,-9,-65,-97,-8, 300,-1,-2, 303,-4,-11,-12,-13,-15,-16,-21,-2,-4,-71, 381,-5,-6,-7,-91,-2,-3, 402,-3,-11,-14,-74, 475,-91,-3,-4,-5,-7,-8,-9, 501,-11,-13,-17, 563,-74,-7,-94, 602,-3,-7,-15,-36,-45,-8, 663,-7,-8,-9, 713,-14,-41,-2,-50.
———, „ of metalliferous deposits, 4, 5, 6, 8, 10, 11, 12, 18, 19, 20,—3, 33,—7, 86, 162,—3, 165,-76,-7,-8,-80,-1,-2,-3,-4,-94,-6, 214,-23,-8,-32,-3,-4,-9,-40,-1,-9,-55,-7, 263,-98, 300,-2,-7,-11,-12,-13,-15,-17, 319,-20,-1,-2,-4,-9,-32,-4,-7,-41,-71,-2,-3, 374,-5,-6,-7,-8,-9,-81, 412,-20,-3,-4,-31, 460,-3,-4,-5,-8,-9,-79,-92, 522,-31,-3,-54, 555,-6,-7,-64,-5,-7,-75,-6,-7,-96-7, 605, 617,-24,-38,-40,-53,-75,-6,-7,-8,-9,-81, 705,-6,-13,-14,-26,-8,-9,-32,-5,-6,-9,-41,-3.
———, „ of *cross-veins*, 226,-32,-86-7, 308,-30,-41, 608,-82, 716.
Quebrada Seca, on the rocks and metalliferous deposits of, 161-3.
Quetelet, M. L. A. J., on the Magnetic declination at Bilbao, 513.
———————, „ temperatures observed at small depths in Brussels, 773-5.
Quincy mine, on the expenditure and profits at the, 459; Table XIV.
Quito, on the mean temperature of, at the surface, and at inconsiderable depths, 771.

Rai, on the copper-bearing beds of talc and quartz at, 4.
Railways, substituted for wheel-barrows and *kibbles* (buckets) in mines, 144, 668.
Rain, in Brazil, 349.
——, in Michigan, 477-8.
Ralfs, John, Esq., on the identity of *diatoms* in Sirocco-dust at Malta, and in the raised and actual beaches of the Pacific, 160.
Ramgunga, auriferous sands of the, 4, 46.
————, detrital matter in the neighbourhood of, but far above its present bed, 45.

Ramgurh, on the iron-ores of, 25.
Rammelsberg, on the iron-pyrites (Sulphur-ore) of, 544,-6.
Ramsay, Prof. A. C., on the Silurian rocks of Merioneth, 635,-6,-7.
————————, „ Copper-turf of „ , 580.
Rampoore, on the conglomerate and iron-ore of, 30; Table II.
Rancié, ventilation effected there by means of a *(trompe)* water-fall, 220.
Raspe, H. R. E., improved operations at *Dolcoath*, whilst he was employed there, 645-6, 7.
————————, his presumed authorship of *Munchausen's Travels*, [645.
Rations, of miners in Chañarcillo, 150; Table V.
———, of slaves in Brazil, 292.
———, „ Virginia, 382.
Ratios at which the temperatures of mines increase with their depths, 759.
Rawlings, W. J., Esq., on the silver-ores of *West Darlington*, 116-117.
————————, „ proportions of tin-ore in the vein-stones of *Wheal Busy*, 472.
Readwin, T. R., Esq., on the *Clogau* gold-mine, 635,-8.
Reay, W., Esq. (& Walker, Dr. T.), on the proportion of gold contained in clay-slate at *Morro Velho*, 186,-96.
————————————, „ processes and products of *(dressing)* cleaning

Rocks, of talcose and micaceous slate, sprinkled with gold, 177, 210-299, 301,-11,-20.
——, „ , „ vitreous copper, 495.
——, of clay-slate, ... „ gold, 196, 210.
——, of calcareo-siliceous nature, „ gold, 245,—9, 304,-19,-24.
——, of *Itabirite* and *Jacotinga*, „ gold, 214,—15, 219,—42,—9, 255,-99, 325.
——, of conglomerate..... „ native copper, 403,-75.
——, of limestone, ... „ native silver and the ores of silver, 76.
——, of the coal-measures, ... „ copper-ore, 503, 506-10.
——, of the New Red Sandstone, „ copper-ore, 514.
——, *Canga*, ... „ gold, 217,—37, 316. native copper, 236,-316.
Rees, Dr. A., on the silver-ore of *Wheal Jewel* (near Callington), 116.
——, „ proportions of silver in the lead-ores of Beer Alston, 109-10.
Reich, H. F., on the temperatures of mines in Saxony, 757.
Remains. (See *Organic Remains.*)
Rhine, on the auriferous sands of the, and on the proportions of gold in them, 348,-51,-8.
——, „ , number and earnings of the population employed on them, 358.
Richards, Mr. I., on the precipitation of copper at the *Devon Consolidated* mines, 584.
Richards, Capt. J., on the comparative values of wheel-barrows and tram-waggons in mines, 144.
Richards, W., Esq., on ventilation by means of falling-water, 220.
Rio de Janeiro, on the mean temperature of, 771.
Rio Tinto, on the (pyrites) sulphur-ores of, 543,-6.
——, „ precipitation of copper at, 589,-92.
Ripple-structure in schistose rocks, its relation to subjacent granite, 259.
——, „ to *shoots* (masses) of gold, 259,-63,-4,-9.

Rita, Santa, on the auriferous talc-slate of, 177.
Rivers, their disappearance beneath, and reappearance beyond, beds of *detritus*, 43,-4, 353.
——, their gradual diminution on the destruction of forests at their sources, 137-41, 343-8.
——, existing, unequal to transporting the coarser and heavier *detritus*, 348.
——, which receive much mineral-water, existence of fish in, 354–355, 717,-31.
Rivot, M. L. E., on the rocks of the Lake Superior mining district, 391,-2,-4,-5,-6, 397,-8,-9, 400, 401,-2,-3,-4.
——, " metalliferous deposits of " , 405,-6,-7,-23, 424,-5,-32,-4,-5, 436,-7,-8,-9,-61, 462,-4,-75.
——, " mode and cost of extracting (native) copper from the mines ..... " , 427-8.
——, " produce of the mines at " , 488.
——, " ancient mining works at " , 412-13,-17.
——, " different proportions of

Rogers, the Rev. Canon, on the serpentine of the Lizard, 647.
———————, „ hornblendic rocks of Saint Clere, [662,-71, 701.
Romero, silver exported from, 153.
Rope, of straw, used on a windlass in the Himalaya, 53.
——, of hemp and iron-wire, comparative values of, 143.
Rooke, Mr. S., on the manufacture of charcoal in Brazil, 262.
Röraas, on the use of pine-splinters instead of candles } underground at, 52.
——, „ formation of ice ..... „ , 479.
Rose Bridge collieries, subterranean temperature at the, 755.
Rose, East Wheal, on the produce and profits of, 454; Table XIV.
———————, „ proportion of silver in the lead-ore of, 120.
Rose, M. Gustav, on the gold-mines of *Berezovsk*, 340.
———————, „ alloys of gold in the Ural and Altai, 335.
———————, „ specific gravities of native and of molten gold, 335, 431.
Rose, Wheal (Newlyn), on the argentiferous lead-ore of, 119.
Rose, Wheal (Sithney), on the argentiferous lead-ore of, 119.
Roskear, North, proportion of tin-ore in the vein-stone of, 472.
———————, ventilation of works by falling-water at, 220.
———————, precipitation of copper from mine-water at, 589.
———————, produce and profits of, 448; Table XIV.
Ross, Capt. Sir J. C., on Magnetic declination, 515,-31, 603,-47, 737.
Rossa Grande, on the auriferous talc-slate of, 178, 247.
Royalties, on gold (mine and detrital), in Siberia, 347.
———, „ „ , in Brazil, 208,-89, 361-70; Tables VII. IX. XIV.
———, on mines (iron and copper), in the Himalaya, 62.
———, „ (copper), in Ireland, 442, 601; Table XIV.
———, „ (copper, lead, and tin), in Cornwall and Devon, 443-59, 694, 719; Table XIV.
Rubbish, proportion of, drawn to the surface, at *Carn Brea*, 143.
———, „ of tin-ore extracted from, at *Polberro*, 202.
———, „ of silver and silver-ore contained in unwashed (undressed) at Chañarcillo, 93, 148.
Ruby; notice of one discovered in the *crop* of a fowl, 356.
Rudberg, Prof., on temperatures at various inconsiderable depths in Upsal, 778.
Rule, John, Esq., on the commencement of *levels* and *winzes* } at *Dolcoath*, 146.
———————, on ventilation by means of falling-water } „ , 220.

Rule, John, Esq., his plans and sections of the works } at *Dolcoath*, 448.
Rutter, Capt. W., on the comparative economy of wheel-barrows and tram-waggons in mines, 144.

Sabará, prosperous condition of the gold-mines near, 368.
Sabine, Gen. Sir E., on Magnetic declination, 372, 492, 513,—15, 520,-31,-41,-75, 603,-16,-37,-47,-73, 703,-37.
Sacramento (Chili), exportation of silver from, 153,
Sacred-lakes (Thibet), notice of gold obtained from them, 48.
Sahloo, on the rocks and iron-ores of, 19.
Salmon, on the abundance of, in New Brunswick, 499.
Salmon, H. C., Esq., on the lead districts of East Cornwall, 699,-704.
———————, „ *lode* of *Wheal Mary Ann* and *Wheal Trelawny*, 706,-9,-14.
———————, „ *lode* of *Herod's-foot*, 712,-13,-14.
———————, „ silver-ores of *Wheal Ludcott*, 710.
———————, „ refuse of ancient lead-mines in the Mendips, 625.
———————, „ winding-engines of *Carn Brea*, 143.
Salter, J. W., Esq., on the fossils of the auriferous series in Wales, 636.
Sampson, B., Esq., his survey & plans of *Wheal Peever*, 226.
———————, on early use of the *plunger-pole*, 570.

Santos, Dr. M. J. dos, on the produce of gold in Brazil, 369.
São Joaõ do Morro Grande, detrital gold *(Cascalho)* wrought by aid of a chain-pump at, 345.
Sark, on the rocks and metalliferous deposits of, 530-8.
——, on submarine works at, 534-9.
——, on subterranean temperature at, 735,-6,-52.
——, on the climate of, 735.
Sauvage, M., on the proportions of silver contained in Spanish lead-ore, 102.
Savings-Bank, established for the slaves at *Gongo Soco*, 293.
Saxony, tin-ore an occasional ingredient of granite in, 77.
——, proportions of silver in the ores of, 101.
Scheerer & Marchand, MM., on the specific gravity of copper after compression, 430.
Schlagintweit, H. A. H. & R., on Magnetic declination, 3.
Schorl, an ingredient of the rocks, 2, 175, 662.
——, „ of metalliferous deposits, 240, 675.
——, „ of detrital „ , 174.
Schreiber, M., „ rocks ..... of *Chalanches*, 517,-19.
——, on the metalliferous deposits „ , 521-2.
——, „ ores ..... „ , 103, 523.
——, „ *cross-vein* ... „ , 527.
——, „ plans and sections of works by, 520.
Schüch, Dr. R., his iron-furnaces at Timbopeba, 212.
Scotland, proportions of silver in the lead-ores of, 105.
Seaton, the valley of, injured by water, mud, and rubbish from the mines near Caradon, 353.
Seccombe, Capt. S., on the positions of the rocks on opposite sides of the *lodes* near Caradon, 658.
Sedgwick, The Rev. Prof., on the rocks of Liskeard, 700.
Seera, on the rocks and copper-ores of, 5.
Seetzen, M., on the noises emitted by moving-sand, 154.
Selwyn, A. R. C., Esq., on the auriferous granite of Australia, 175.
——, „ detritus of „ , 343.
—— (& Ulrich, G. F. H., Esq.), on a large mass of Australian mine-gold, Table XXII.
—— „ , on the chrome-ore of Australia, 649.
—— „ , on the molybdenite of Australia, 654.

Serpentine of Coverack, on the, 647.
——— of Corri Charmaig, on the, 647-8.
Seton, West Wheal, on the produce and profits of, 449 ; Table XIV.
Shales of the coal-measures, at Paunchmaulee, 66.
——, „ , containing fossil plants, near Bathurst, New Brunswick, 503—509.
——, „ , „ and the ores of copper, „ , 503,-9, 510.
Shanagarry, on the rocks and lead-ores of, 619-21.
Sharp Tor, on the different positions of granite and slate on opposite sides of a *lode* near, 659.
Shealgar, on the iron-ores of, 22.
Sheep used as beasts of burthen in the Himalaya, 47.
Shells, of existing species in the raised beaches of Chili, 156.
——, „ , in recent sandstone near Caldera, 155.
——, „ , „ , burnt for the lime they contain, 155.
Sheriff, J. D., Esq., on the elevation of Menheniot, 746.
Shingle, gravel, sand, and shells in the raised beaches near Caldera, [156.
Shoots of copper and copper-ore, 438, 598, 608.
——, of gold, 207,-15,-24,-59,-63,-4,-9,-70, 319,-26,-80.
——, of iron-ores, 32, 553,-64.
——, of lead-ore, 537.
——, of silver and silver-ores, 122, 537,

Siberia, on the auriferous rocks of, 175.
———, „ detrital gold of, 343,-6; Table XXII.
———, „ alloys of gold in, 335.
———, „ Royalties payable by parties working auriferous deposits, 347.
———, „ earnings of workpeople in, 348.
Sicily, proportion of silver in the lead-ore of, 102.
Silliman, Prof. B., on proportions of gold in vein-stone at Walton, (Virginia), 373.
Silurian rocks, of Wicklow, 540–2,
———, of Waterford, 593–5.
———, of Merioneth, 635–6.
Silva, Senr. Guarda Môr I. V. da, his gold-mine at *Pitangui*, 222-3.
Silver and the ores of silver, in the Banat, 100.
———, in Chili, 76, 90,-121,-3-4,-53.
———, in Cornwall,
Bal-dhu, 114.
Crennis, 118.
Cubert (?), 111.
Dolcoath, 112–13.
Fowey Consolidated mines, 118.
Herland, 111–12.
Levant, 110.
North Dolcoath, 113.
North Downs, 114.
Trebisken, 120-1.
Treskerby, 114.
West Darlington, 116-17.
Wheal Alfred, 112.
Wheal Ann, 112.
Wheal Basset, 113.
Wheal Cock, 110.
Wheal Duchy (Wh. Brothers), 114-15.
Wheal Jewel (Calstock), 116.
Wheal Ludcott, 120, 710-11.
Wheal Mexico (Perran-zabuloe) 110-11.
Wheal Mexico (Calstock), 115-116.
Wheal Providence (Tremayne), 118.
Wheal Saint Vincent (East Cornwall mines, *Wheal Langford)*, 115.
Wheal Sisters, 115.
Wilsworthy, 116.

Silver and the ores of silver, } in France, 103,-4, 525-6.
———————, in Hungary, 100-1.
———————, in Ireland, 105, 545,-9,-68.
———————, in Mexico, 97,-8,-9.
———————, in New Granada. 98.
———————, in Norway, 100.
———————, in Peru, 98.
———————, in Sark, 121, 535-7.
———————, in Saxony, 101-2.
———————, in the United States, 99, 436-8.
———————, associated with bismuth, 111.
———————, " ores of cobalt, 103,-11,-12,-16, 523.
———————, " copper and copper-ore, 99, 104, 112, 378, 436-8, 549,-68, 642.
———————, " ores of lead. (See *Lead.*)
———————, " " of nickel, 103, 524.
———————, " gold, 99, 104,-5, 206,-36,-86, 334,-5,-7,-8,-40,-60,-74, 378, 549,—68, 632,—42; Tables VII. IX. X.
———————, " " , in different rocks, 206,-36,

Skips, on their early use in inclined shafts near Tavistock, 144, 668.
——, „ later introduction „ in West Cornwall, 668.
Slags, on the proportions of metal in the *slags* of Brazilian iron-furnaces, 261.
Slate. (See *Chlorite*, *Clay*, *Hornblende*, *Mica*, *Talc*, *Cleavage*, *Joints.*)
Slaves, in Virginia, hire of 382.
——, „ , food of, 382.
——, in Brazil, hire of, 382.
——, „ , employed alternately in mining and in agriculture, 299.
——, „ , permitted to search for gold on their own account during holidays, 301.
——, „ , general economy of the establishment at *Gongo Soco*, 289–96.
——, „ , their occupations and hours of labour, 291–3.
——, „ , the disposal of their leisure, 293.
——, „ , their food, clothing, and dwellings, 290–3.
——, „ , „ earnings (dependent on individual skill and industry), 292–3.
——, „ , „ „ , how appropriated, 292.
——, „ , „ „ , sometimes deposited, at interest, in a Savings-Bank, 293.
——, „ , treatment of old and infirm, 293.
——, „ , „ and instruction of children, 293,-5.
——, „ , „ „ „ , their proficiency at school, 295–6.
——, „ , the aptest scholars, often the most skilful workmen, 296.
——, „ , periodical inspection of their gardens, houses, furniture, and clothing, 291.
——, „ , „ , followed by rewards to the clean, industrious, and careful, 291.
——, „ , „ „ the infliction of fines on the dirty, idle, and extravagant, 291.
——, „ , the ill-behaved were few in number, 295.
——, „ , „ , nature of and punishments for their offences, 293–5.
——, „ , medical treatment of, 295.
——, „ , „ , rations whilst under, 295.

Slaves, in Brazil, Divine worship, observance of, 295.
——, „ , number employed, 290, Table IX.
——, „ , „ who received their freedom, 290.
——, „ , „ in Minas Geraës, 362.
——, „ , „ „ , employed on detrital deposits, 358.
Slickenside, of native copper and earthy matter at the *Cliff* mine, 433.
Slide, influence of a, on the auriferous deposits of *Gongo Soco*, 252, 266,-70.
——, displacement occasioned by a, in the *lode* of the *Cliff* mine, [439.
——, unknown in the granite of Caradon, 686.
Smelting, iron-, in the Himalaya, 54-62.
——, „ , in Brazil, 212,-18-19,-60-2.
——, „ , near Lake Superior, 389-90.
——, silver-, in Chili, 97.
——, iron-, early, in India, 40, 65.
——, copper-, „ , in Chili, 154.
Smyth, R. B., Esq., on the quantities and proportion of gold in the } auriferous quartz of Australia, Table XXII.
——, „ „ detrital deposits of Australia, Table XXII.
——, „ numbers and weights of masses *(nuggets)*

Smyth, W. W., Esq., on the conformable bodies of slate which interlie the ore, 551.
——————, on parallel ranges of *Sulphur* and copper-ore, 547,-53-4,-6.
——————, on the occurrence of native copper in joints and crevices, 556.
——————, „ "cross-deposits" and "cross-fissures," 556-7.
——————, on displacements of the *Sulphur-course*, 559-[560.
——————, on the produce of mines in Wicklow, 561.
——————, „ rocks of ..... *Bearhaven*, 602,-3-4.
——————, „ metalliferous deposits of „ , 603—4, 610-11.
——————, „ detrital gold of Wicklow, 628,-9,-30-631,-2,-4.
——————, „ „ tin-ore of „ , 630-1.
——————, „ alleged waste of copper-ore in Cornwall, 690.
——————, „ erection of a steam-engine underground at *Bearhaven*, 609.
——————, „ early use of the *plunger-pole* in Cornwall, 570.
——————, on wooden linings for pumps conveying acidulous water, 570.
——————, „ submarine mines near Whitehaven, 599, 600.
——————, „ subterranean temperature, 727,-53-4,-9, 762-3,-5.
Esq., on the proportion of fine copper contained in the crude (native) metal of ..... } the *Cliff* mine, 435.
—, „ produce and profits of..... „ , 440, [459; Table XIV.
Himalaya, 17.
phiny; the impedime ' offer to mining in elevated reg) 528.
in the Himalaya, im by, 58-9.
(de Gouvêa), on the
formations in 182, 7,
Crotus sands near, of *G* *o*
ments with, on

Soda, salts of, incrust a great extent of surface near Monte Amargo, 139-40.
——, „ washed out of the soil at Ramadilla, before it can be successfully cultivated, 141.
Soils dissimilar, different qualities of charcoal from wood grown on, Sooal, on graphite imbedded in clay-slate, near the, 41. [219,-390.
South Caradon. (See *Caradon, South.*)
South Cliff mine, on the *drift* of the, 460.
——————, „ rock, vein-stones, and native copper of the, 460-3 ; Table XIII.
Southey, Rob., Esq,, on the detrital gold of Brazil, 343,-60.
——————, „ Royalties payable on „ , 361,-2,-3,-6.
——————, „ restrictions on the export of „ , 364,-5.
——————, „ quantities of..... „ ,exported without payment of Royalty, 365,-70.
——————, „ debasement of „ , by smugglers, [365.
South Tolgus mine, on the produce and profits of, 459.
Souza, Senr. M. T. de, on the amount of Duties received by the Government of Brazil from *Gongo Soco*, 367.
Spain, proportions of silver in the lead-ores of, 102-3.
Speculator, sharp practice of a, 514.

Stamping-mills, weight of *stamp-heads*, at *Agoa Quente*, Table XXII.
———, „ , at *Catta Preta*, Table XXII.
———, „ , in California, Table XXII.
———, „ , in Australia, Table XXII.
———, „ , at *Copper Falls*, 426.
———, „ , at *Henwood*, 473.
———, height to which the *heads* are lifted } at *Morro Velho*, Table XXII.
———, „ at *Gongo Soco*, Table IX.
———, „ in California, Table XXII.
———, „ at *Copper Falls*, 426.
———, rate at which the *heads* are worked } at *Morro Velho*, Table VII.
———, „ at *Gongo Soco*, Table IX.
———, „ at *Copper Falls*, 426.
———, quantity of water admitted to aid the stamping ..... } at *Morro Velho*, Table VII.
———, „ at *Gongo Soco*, Table IX.
———, preparation of vein-stone for the Stamping-mill in the Keweenaw district, 425.
———, weight of ... „ stamped at *Morro Velho*, Table VII.
———, „ „ „ at *Gongo Soco*, Table IX.
———, „ „ „ in California, Table XXII.
———, „ „ „ in Australia, Table XXII.
———, „ „ „ at *Copper Falls*, 426.
———, „ „ „ at the *National* mine, 471.
———, cost of stamping „ in California, Table XXII.
———, „ „ in Australia, Table XXII.
Stamp-work, how prepared, 425.
———, proportion and quality of, at the *Cliff* mine, 434-5.
———, „ , „ *National* mine, } 471-2.
———, „ , „ Lake Superior districts generally, 482.

Stanniferous granite of Cornwall and Devon, 175, 664-6.
Statistics, sundry, of Copper-mining, in Cornwall, 442,-5,-7,-8,-9, 450,-1,-2,-4,-6,-7,-9, 693, 694,-5,-8; Table XIV.
———, ,, , ,, in Devon, 458,-9; Table XIV.
———, ,, , ,, in Ireland, 442, 601; Table XIV.
———, ,, , ,, near Lake Superior, 440,—59, 470,-1,-3,-82,-8,-9; Table XIV.
———, ,, , ,, in Chili, 154,-66-7.
———, ,, , ,, in Cuba, 441; Table XIV.
———, ,, , of Gold-mining, in Wales, 641; Table XXII.
———, ,, , ,, , in Ireland, 633.
———, ,, , ,, , in Australia, Table XXII.
———, ,, , ,, , in Brazil, 179, 208,-35,-47,-83, 289, 327,-58,-61-3,-66-9; Tables VII. IX. X. XIV. XXII.
———, ,, , ,, , in California, Table XXII.
———, ,, , ,, , in Nova Scotia, Table XXII.
———, ,, , ,, , in Siberia, 177-8, 346; Table XXII.
———, ,, , of iron-mining, near Lake Superior, 389-90.

Stevenson, James, Esq., on the depths of Australian gold-mines, Table XXII.
Stones, sculptured, at Dhoora Devi, in the Himalaya, 19.
Stopes (Steps), substitution of one system of, for another, 145-6, 645-646,-93.
——, *back*, adopted earlier in Germany than in Cornwall, 646.
Stowes mine, rocks and metalliferous deposits of the, 676-7.
Strachey, Capt. R., on beds of graphite near Almora, 41.
——————, on the disappearance and reappearance of rivers in the Turaee, 44.
Strata, dissimilar, their different influence on (masses) *shoots* of ore and of vein-stone in the metalliferous deposits which intersect them, 187, 224.
——, " , their coincident positions in the opposite sides *(walls)* of metalliferous deposits, 87, 126,-9.
——, " , their coincident positions on the opposite *walls* of certain *cross-veins*, 71, 126,-9.
——, " their different positions on the opposite *walls* of certain *cross-veins* ..... } 71—2, 126,—30, 225-6,-86-7, 341, 342.
——, " " , which merge in them elsewhere, 226-7,-87, 342.
Streams, action of, on the matrix of tin-ore, 354.
——, " gold, 354.
Stream-tin-ore, of Caradon, 695.
——————, of Australia associated with gold and platina, 286.
Strikes, their utility in cleaning *(dressing)* auriferous sand in Brazil, Tables VII. IX.
Strike, in metalliferous deposits, 207, 433,-69, 552-3, 648,-54.
——, in *cross-veins*, 125, 683.
——, crooked and divergent, 469, 683.
Structure. (See *Cleavage*, *Joints*, *Cross-veins*, *Metalliferous deposits.*)
Submarine mining-works, at *Sark's Hope*, 534,-9.
——— " , at *Knockmahon*, 594,-9-600.
——— " , at *Wheal Margery*, 599.
——— " , at *Levant*, 599.
——— " , at *Botallack*, 599.
——— " , at *Whitehaven*, 599.
Sulphur-ore (iron-pyrites), of Wicklow, 543-69.
Surface-water intercepted by impermeable limestone at Chañarcillo, [77.

Superior, Lake, rocks on the southern shore of, 385-404.
———, deposits of iron-ore of „ , 388-90.
———, „ native-copper „ , 419-83.
———, „ native silver „ , 436.
———, ancient mines and miners „ , 412-19.
———, climate of, 477-8.
———, subterranean temperature near, 733-4.
———, ice remaining during summer in some of the mines near, 465,-78, 734.
Surubim, unesteemed fresh-water fish, lives in rivers polluted with mineral-water, 355.
Swanpool, proportion of silver in the lead-ore of, 120.
Swings of iron-chain numerous near heathen temples in the Himalaya, 28.
Symons, Mr. F. S., on the proportion of gold in *(killas)* slate at *Morro Velho*, 186.

Taboleiro, on the manufacture of iron at, 260-2.
———, „ mass *(nugget)* of detrital-gold found near, 283.
Tacquarigua, level of water in the lake of, affected by the condition of neighbouring woods, 138.
Talapoongla, on the rocks and copper-ores of, 7.
Talc, an ingredient of the rocks, 4, 5, 6, 7, 9, 19, 20,-3,-5, 171,-2,

Tavistock, subterranean temperature in the mining district of, 752.
Taxes on wood, charcoal, and lime in the Sub-Himalaya, 40.
Taylor, John, Esq. (of London), on early copper-mining in Cornwall, 691,-2.
Taylor, John, Esq. (of Caradon), on the silver-ores of *Wheal Ludcott*, 711.
——————— „ , „ financial operations at „ , 719.
——————— „ , „ copper precipitated from spring-water at Crow's-nest, 686.
Taylor, Capt. J., on the proportions of tin-ore in the vein-stones of *Balleswidden*, 472.
Tellurium, alloyed with gold, in the talc-slate of Brazil, 299, 334,-6,-7, 640.
———, „ „ , at *Descoberta*, 299.
———, „ „ , at *Coelho*, 180.
———, „ „ , at *Catta Branca*, 336.
———, „ Virginia, 336,-76,-82, 640.
———, alloyed with gold, in the Silurian rocks of Merioneth, 640.
Tennant, Prof., on a *(nugget)* mass of gold discovered in Australia, Table XXII.
Tennent, Sir J. Emerson, on the discovery of a ruby in a fowl's crop, 356.
Temperate regions, subterranean temperature in, 761,-2; Tables XXXI. XXXV. XXXVI.
Temperature, subterranean, in Chili, 724-5,-51; Table XXXI.
———, „ , in Brazil, 725-32,-51.
———, „ , in the United States, 732-4,-51.
———, „ , in the Channel Islands, 734-7,-52.
———, „ , in Ireland, 737-44,-52.
———, „ , in Cornwall, 744-9,-52.
———, „ , in Shropshire, 750-1,-2.
———, „ , in different rocks, 753-6,-60,-2; Table XXXIII.
———, „ , in mines affording different metals and ores, 756-7,-8,-61,-2; Table XXXIV.
———, „ , „ „ similar metals and ores in different rocks, 757-758; Table XXXV.
———, „ , „ at different elevations, in tropical and in temperate regions, 758,-61; Tables XXXI. XXXV. XXXVI.

Temperature, subterranean, changes in, at given spots, by deepening and extension of neighbouring mines, 764–5.
———, „ at inconsiderable depths, } in Brazil, 767—78; Table XXXVII.
———, „ , „ , in New Granada, 770.
———, „ , „ , in Ecuador, 771
———, „ , „ , in India, 772,-8, 80.
———, „ , „ , in Belgium, 774-5.
———, „ , „ , at Greenwich, 776-7.
———, „ , „ , near Truro, 779.
———, „ , „ , near Edinburgh, 777-
———, „ , „ , at Upsal, 778. [778.
Thesoureiro, on the rocks and auriferous deposits of, 302-3.
Thieves, conviction of, from the peculiar alloy of the stolen gold, 336.
Thomas, Capt. Charles, on the granite of Caradon, 663.
———, „ proportions of tin-ore in the vein-stones of *Dolcoath* and *Cook's-kitchen*, 472.
———, „ silver & silver-ores of *Dolcoath*, 113.
———, „ progress of works at „ , 448.
———, „ action of running-water in separating tin-ore from its matrix, 354.
———, „ produce and profits of *Dolcoath*, 447-

Thost, C. H. G., Esq., on the mica-slate and serpentine of Corri Charmaig, 645.
———————, „ greenstones & porphyry of Breadalbane, 651.
———————, „ *lodes* of Breadalbane, 652.
Throw. (See *Displacement.*)
Thunderstorm at *Catta Branca*, effects of, 179.
Thury, M. Héricart de, on the rocks ..... of *Chalanches*, 517,-19.
———————, „ metalliferous deposits „ , 523-4.
———————, „ ores they afford, 103, 524.
———————, „ proportion of silver in lead-ore from Vizille, 103.
Tigrony, on the rocks of, 542.
———, „ sulphur-ores of, 553-4.
Tilporà, on the iron-ores of, Table II.
Tijuco, on the slates and auriferous quartz of, 182.
Timber, quantities of, in the forests near Lake Superior, 390.
———, of heavy growth, on the rubbish of ancient mines, 416.
Timbopeba, on the iron-furnaces of, 213.
Tincroft, on the granite and slate of, 658.
———, proportion of tin-ore in the vein-stone of, 473.
———, ventilation obtained at, by means of a fall of water, 220.
Ting Tang, on the profit realized at, 451; Table XIV.
Tin-mines, subterranean temperature of, 757,-8; Table XXXIV.
Tin-ore, an occasional constituent of rocks, 77, 175, 664-5.
———, proportion of, in the vein-stones of Cornwall, 472-3, 693.
———, on the presumed association of it with fluor, 680.
———, „ separation of, from its matrix by running-water, 354.
———, on proportions extracted by tributers, ...
———, „ „ tutwork-men, } at *Polberro*, 202.
———, „ culled from rubbish by day-labourers,
———, detrital, mixed with gold, in Wicklow, 630-1.
———, „ , „ , in Banca, 631.
———, „ , „ , in Australia, 286.
———, „ , „ and platina, in Australia, 286.
———, „ , superior to mine-tin-ore in quality, 359.
———, „ , Roman remains in partially worked beds of, 345.
Titanite, crystals of, imbedded in crystals of quartz in *Itabirite*, at *Agoa Quente*, 225.

Tolgus, South, produce and profits of, 459.
Toltec mine, rocks and copper-deposits of, 463-5.
————, ice accumulated in the works during winter, remained unthawed in summer, at, 465, 734.
Tomlinson, C., Esq., on crystallization from supersaturated solutions, 713.
Tomnadashan, on the mica-slate, greenstone, and porphyry of, 650-2.
————, „ molybdenite of, 654.
Tonkin, Capt. John, on blasting the rocks and vein-stones at *Dolcoath*, 220.
Tonkin, Thomas, Esq., on early copper-mining in Cornwall, 686-7.
————, on *dressing* the poorer kinds of tin-ore, 689.
Tools, mining, inefficient, used in the Himalaya, 51.
——. „ , „ , used by native miners in Brazil, 217,-18, 221,-99.
——, „ , peculiar use of certain, at St. Just and in Chili, 151.
——, „ , unusual, tried unsuccessfully at *Morro Velho*, 199.
Topaz, matrix of, near Cattas Altas, 300.
——, mines of, at Capaõ and Boa Vista, 305-8.
Torches of resinous wood used to give light in mines, 52.
Torcy, subterranean temperature at, 753.
Towan, Wheal, profit made at, 454 ; Table XIV.
————, experiments on the discharge of water from pumps at, 570.

Treatment of auriferous vein-stones, Tables VII. IX.
———, different modes of, serve to extract different proportions of gold from similar vein-stones, 198.
Trebilcock, Capt. J., on the auriferous deposits of *Gongo Soco*, 257.
———, „ of *Antonio Pereira*, 304.
Trebilcock, Mr. W., on the profit made at *Carnon Stream*, 452; Table XIV.
Trebisken Green, proportions of silver in the ores of, 121.
Tredinnick, Capt. S., on the proportions of tin-ore in the vein-stone of *Great Work*, 472.
Treffry, J. T., Esq., on the produce and profits of the *Fowey Consolidated* mines, 456; Table XIV.
Tregoning, Capt. W., on the iron-formation of *Gorgo Soco*, 260.
———, „ auriferous deposits of „, 255-72.
Trehane, Wheal, proportions of silver in the lead-ores of, 120.
Trelawny, Wheal, on the rocks of, 700-3.
———, „ *lode* of, 704-15.
———, „ proportions of silver in the lead-ores of, 120,-708,-9.
———, „ *cross-veins (flucans)* of, 715-17.
———, „ rate at which the works have been deepened, 748.
———, „ machinery at work and population employed at, 720.
———, „ produce and profits of, 719,-20.
———, „ subterranean temperature at, 748.
Trelawny, North Wheal, proportions of silver in the lead-ores of, [120.
Trelawny, South, rocks and vein-stones of, 714.
———, machinery worked and population employed at, [720.
———, subterranean temperature at, 748.
Trelcar, Capt. T., on the rocks of *Morro Velho*, 186.
———, „, proportions of gold contained in certain parts of, 186,-96.
———, „, relations between them and the principal auriferous deposits, 186,-7,-92,-3,-5,-6, 207,-8.
———, „, circumstances which affect the richness of the formations, 189, 190,-5,-6,-7.

Treloar, Capt. T., on the deposits at *Morro Velho*, } endlong dip *(shoot)* of ore, 207,-8.
——————, „ , beds of rock which sever portions of them, 192,-3.
——————, „ , issue of inflammable gas from crevices in the auriferous portions of, 195,-6.
——————, on the extent of water-courses at *Morro Velho*, Table XXII.
——————, „ proportion of gold obtained from *Jacotinga* at *Don Pedro North d'el Rey*, Table XXII.
Treloar, Capt. W., on the proportion of gold obtained from the vein-stone of (the *Camara*) *Gongo Soco*, 247.
Trelyon Consolidated Mines, proportion of tin-ore in the vein-stone of, 472.
Tremayne (Providence) Wheal, native silver in the lead-ore of, 118.
Tresavean, precipitation of copper from mine-water at, 588,-92.
————, produce and profits of, 451; Table XIV.
Treskerby, profits of, 451; Table XIV.
Tres Puntas, silver exported from, 153.
Trethevy, cromlech of granite, within the slate formation at, 660.
Trethevy mine, on the hornblendic rocks of, 671.
Trevandrum, temperatures on the surface, and at various (inconsiderable) depths, near, } 771,-2,-8,-80.

Trompe, a (pneumatic trough filled by aid of falling-water) method used for obtaining a blast by the iron-smelters of Brazil, 219.
———, „ , for ventilating mines, 220.
Tropical regions, subterranean temperature in, 724-32,-51,-9-62; Tables XXXI. XXXV. XXXVI.
Truro, temperatures, at inconsiderable depths, in ground of different kinds, near, 779.
Turaee, disappearance of streams in, and their reappearance beyond the gravel of the, 43-4.
———, pestilent swamps of the, 44,
———, the, deserted by living creatures at certain seasons, 40.
———, ice formed amongst tropical vegetation at other „ , 45.
Turvo, on the schorlaceous granite of, 175.
Tutwork-men (paid by measurement of the work they perform), proportion of tin-ore extracted by, at *Polberro*, 202.
Tutyl, on the calcareous-slate and specular iron-ore of, 33,-5.
Tyndrum, on the ores of lead and of cobalt at, 643-4.

Ulauyaly, M., on the detritus of the Ural, 343.
———, „ detrital gold of, „ , 346; Table XXII.
———, „ Royalties paid by searchers for gold in Siberia, 347.
Ulloa, M. M. de, on beds of shells at great elevations in Chili, 159.
Ulrich, G. H. F., Esq. (& Selwyn, A. R. C., Esq.), on the chrome-ore of Australia, 649.
———, „ molybdenite of „ , 654.
———, on a large mass *(nugget)* of Australian gold, Table XXII.
United Mines, on the introduction of (water-fall) pneumatic ventilation at the, 220.
United States, proportions of silver in various lead-ores of the, 99.
Unity, Wheal, profits made at, 452; Table XIV.
Upsal, temperatures at inconsiderable depths near, 778.
Ural, on copper-ores in the coal-measures of the, 508.
——, on deposits of gold and platina, in the, 340.
——, on the origin of detritus in the, 343.
——, „ detrital gold of the, 342.

Valenciana (Chili), extent and produce of works at, 123.

Valenciana (Chili), quantity, quality, and value of silver-ore afforded by, Tables IV. XIV.
Valleys, directions of, in West Cornwall, 718.
Veins. (See *Metalliferous deposits.*)
Veins, cross. (See *Cross-veins.*)
Veins, pipe, of lead-ore, 620. (See *Pipe-veins.*)
Vein-stones. (See *Composition of metalliferous deposits.*)
Ventilation, natural, by the issue of air from joints in rocks, 250.
————, artificial, by pneumatic means, 219-20.
Verneuil, M. E. de (Murchison, Sir R. I., & Keyserling, Count A. von), on the copper-ores of the Uralian coal-measures, 508-9.
————, on deposits of gold and platina in the Ural, 340.
————, on detritus of the Ural traced to its origin, 343.
————, on detrital gold of the Ural, 342.
————, on the large *(nugget)* mass of detrital gold in Siberia, Table XXII.
Verran, Capt. W., on the *shoots* of auriferous vein-stone at *Morro Velho,* 207.
Vicente, Saõ, tellurium an alloy of gold in the neighbourhood of, 180.
Victoria (Australia), quantities of gold obtained in and exported from, Table XXII.
——— „ , detrital gold of, traced to its origin, 343.
——— „ , numbers and weights of large *(nuggets)* masses discovered in, Table XXII.

Vivian, Capt. Nicholas, on the metalliferous deposits of *Sark's Hope*, 531,-2,-5-6.
——————, „ economical application of steam-power to winding-engines, 142.
——————, „ comparative values of wheel-barrows and tram-waggons underground, 144.
——————, „ ventilation of mines by the use of falling-water, 220.
——————, „ profit of *Wheal Towan*, 454; Table XIV.
Vivian, William, Esq., on the structure of smelted copper, 430-1.
——————, „ „ precipitated „ , 431.
——————, „ „ native „ , 431.
Vivian, William Cock, Esq., on the proportions of tin-ore in the vein-stones of *North Roskear*, 472.
——————, „ copper precipitated from the water in *Roskear adit*, 589.
——————, „ produce and profits of *North Roskear*, 448-9; Table XIV.
Vor, *Wheal*, proportion of tin-ore in the vein-stones of, 472.
——————, subterranean temperature at, 764-5.
——————, forges for sharpening tools underground at, 610.
——————, profit and loss at, 446; Table XIV.
Vughs (cavities) in the *lodes* at Chañarcillo, 89, 126.
—— „ „ near Lake Superior, 430.
—— „ „ of Cornwall, 89.
Vulcan mine, large trees grown on the rubbish from ancient copper-works at the, 416.
Vyvyan, *Wheal*, on the copper-bearing granite of, 512.

Wages. (See *Miners.*)
Wales, proportions of silver in the lead-ores of, 105,-6,-7.
——, miners brought from, to work in the mines of North Devon, 109.
Walferden, M., on the temperatures of coal-mines in France, 753-4.
Walls of *lodes*, rocks which form confronting portions on opposite sides } in Chañarcillo, 87, 130.
——————, „ in Cornwall, 657-60.
—— of *cross-veins*, „ in Chañarcillo, 71, 130.
Walker, Dr. T. (& Reay, W., Esq.), on the proportion of gold in the slate at *Morro Velho*, 186,-96.

Walker, Dr. T. (& Reay, W., Esq.), on the processes and products obtained in *(dressing)* cleaning gold at *Morro Velho*, 203.
Walsh, The Rev. Dr., on the gold-mine of *Antonio Pereira*, 303.
Walton mine, proportion of gold in the vein-stones of the, 373.
Waring, E. P., Esq., on magnetic declination at Chañarcillo, 69.
Water, spring-, diminution of, when the neighbouring surface is stripped of wood, 137-40, 344.
————-, temperature of, in Brazil, 728.
————-, „ , in the Channel Islands, 735,-7.
————-, „ , in Ireland, 738,-40.
————-, „ , in East Cornwall, 745,-6,-8,-9.
———— (fresh), in mines wrought beneath the sea, 539.
———— „ , „ a surface encrusted with the sulphate of soda, 165.
———— „ , yielding a precipitate of copper, 686.
———— „ , prices of, in Chañarcillo, Table V.
——-, river-, unequal quantities of, at different seasons, 43, 140.
————, action of, in separating metallic from earthy minerals, 354.
————, now disappearing in gravel of ancient beds, 43-4, 139-40.
————, but reappearing on reaching impermeable clay at a lower level, 44.
————, holding in solution salts but depositing them during

Water, mine-, fish thrive in, 355, 717-18,-31.
——, ——, entire absence of, in the deep works of Chañarcillo, 70,-148.
——, ... „ , prevents extraction and preparation of much silver-ore at Chañarcillo, 138.
——-wheel, constructed without the use of metal, 345.
——, fall of, applied to ventilating mines, 219-20.
——, „ the blasts of forges and iron-furnaces, 219, [528.
Waterford, on the mean temperature at, 739.
Waters, Sampson, Esq., on gold imbedded in grey copper-ore, 378.
Weapons, ancient, of native copper found near Lake Superior, 418-[19.
Weaver, T., Esq., on the clay-slate of Waterford, 593.
——————, „ metalliferous rocks of Wicklow, 540,-1-2.
——————, „ „ deposits of „ , 543,—5, 549-50,-3,-4,-5,-6.
——————, „ precipitation of copper from mine-water } at *Cronebane*, 562, 573.
——————, „ auriferous native silver of „ , 105. 549.
——————, „ detrital gold of Wicklow, 627,-8,-9,-30,-1.
Webb & Geach, Messrs. (See Geach & Webb, Messrs.) [633,-4.
Wellington, Mr. R., on the proportions of tin-ore in the vein-stones of *Condurrow* and *Ding Dong*, 472.
——————, „ (early) profits of *Botallack*, 442.
Wells, on the temperatures of water in, 735,-7,-8,-40,-5,-8,-9.
Wendron Consolidated Mines, proportion of tin-ore in the vein-stone of, 472.
Werner, H. A. G., on the relations between metalliferous deposits and the rocks which adjoin them, 187.
West, William, Esq., on the *lodes* of the *Phœnix Mines*, Table XXV.
Westmoreland, proportions of silver in the lead-ores of, 109. [Note.
What-Cheer mine, on the metalliferous deposits of the, 465.
Whims, horse-, available only for the shallower parts of mines in Chañarcillo, 142.
——————, erected underground, 76.
Whitehall (Virginia), on the deposits of gold and tellurium at, 376.
Whitley, Nicholas, Esq., his Geological map of the Caradon district, 655.
——————————, on the structure of the Cheesewring granite, 672.
——————————, „ stanniferous granite of Gonamena, 665.

Whitley, Nicholas, Esq., coincidence of the directions of the joints in rocks with the valleys in West Cornwall, 718.

———————, „ temperature of ground of various kinds near Truro, 779.

Whitney, J. D., Esq., on the sandstones, conglomerates, and trap-rocks of Lake Superior, 392—404, 423,-38,-9,-75.

———————, „ directions and dips of the copper-deposits of Lake Superior, 404,-7,-9.

———————, „ vein-stones of the copper-deposits of Lake Superior, 424,-5,-61,-2,-3,-4,-7.

———————, „ native copper of the copper-deposits of Lake Superior, 435,-62,-3,-7,-76,-80.

———————, „ extraction of native copper in large masses at Lake Superior, 427.

———————, on the *drift*, and on the occurrence of masses of native copper in it, at Lake Superior, 460.

———————, „ native silver associated with native copper at Lake Superior, 99, 419,-37.

———————, „ prehistoric mines and miners } of Lake Superior, 412, 414,—15, 417,-19.

———————, „ mining leases granted at „ , 487.

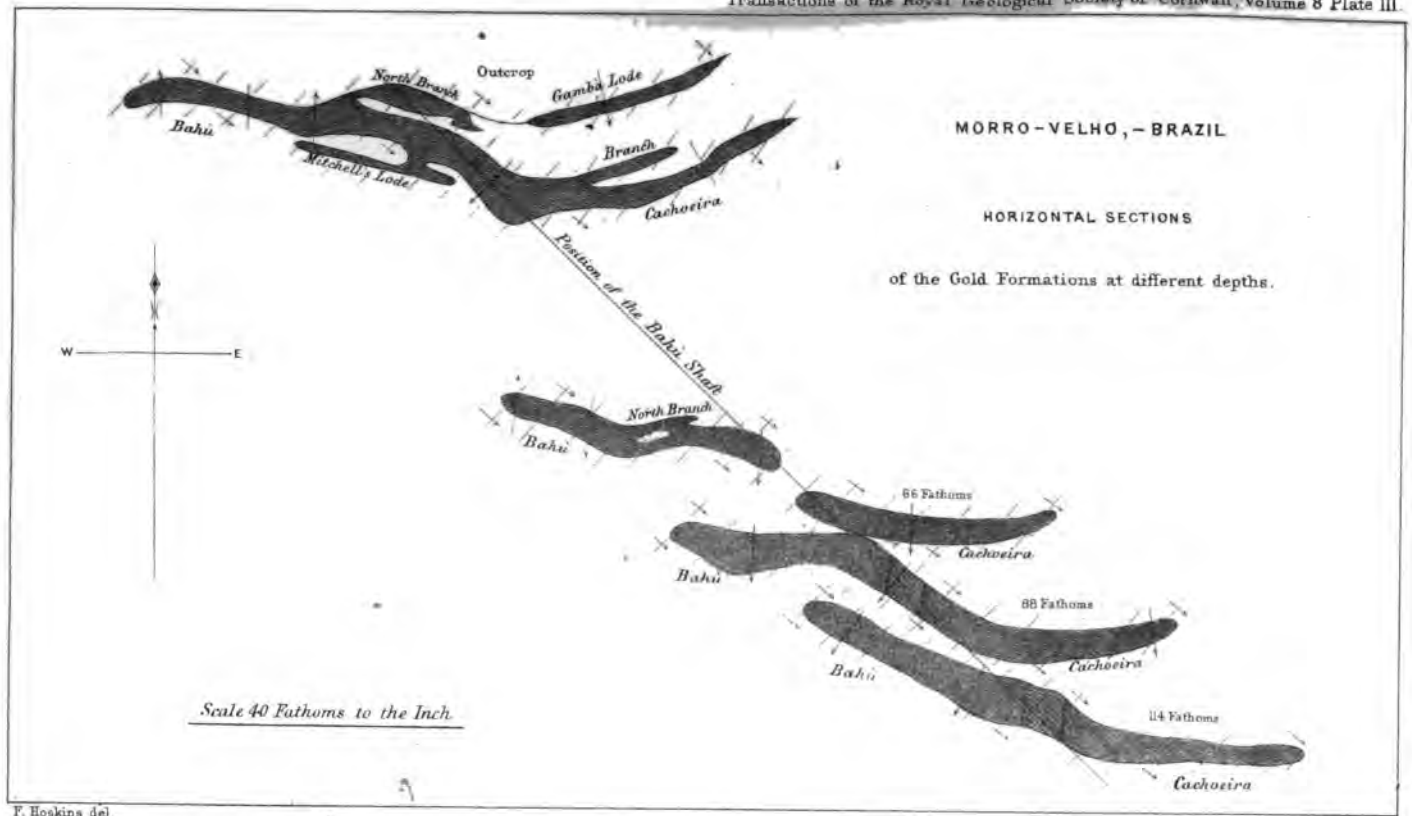
Wicklow, on the cost of extracting *Sulphur-ore* (pyrites) and wages of the workmen employed, 561-2.
———, „ auriferous silver of, 105, 549.
———, „ mine-gold of, 549-50.
———, „ detrital gold of, 627-34.
———, „ „ tin-ore of 630-1.
———, „ precipitation of copper from mine-water in, 560-89.
———, „ temperature of wells in, 738.
———, „ subterranean temperature in, 738.
Width. (See *Metalliferous deposits.*)
Willcox, E. N., Esq., on the produce of copper-mines near Lake Superior, 488-9.
Williams, Henry, Esq., on the quantity of copper-precipitate obtained from the water of the Gwennap *adit*, 587.
Williams, Mr. James, on the precipitation of copper from mine-water at the *Parys* works in Anglesea, 581.
Williams, John, Esq. (of Burncoose), the *Poldice* (Gwennap) *adit* commenced and extended by, 586.
Williams, John, Esq., jun. (of Burncoose), on the displacements of *lodes* at *Wheal Peever*, 226.
Williams, John, Esq. (of Swansea), quantities and qualities of copper-precipitate from *Cobre* (Cuba), 591.
Williams, Michael, Esq., on the *Slide* at *Gongo Soco*, 252.
Williams, Sir William, on the silver-ore of *Wheal Basset*, *North Downs*, and *Treskerby*, 114.
———————, „ profit realized at *Godolphin*, 445; Table XIV.
———————, „ „ in sundry of the Gwennap mines, 451; Table XIV.
———————, „ „ at *Gunnis Lake*, 457; Table XIV,
Williams, Capt. William, on the effects of a thunderstorm at *Catta Branca*, 179.
Wilkin, Capt. John, his attempt to establish systematic mining in the Himalaya, 52.
Wilkins, Fort (Lake Superior), annual mean temperature of, 477.
Willson, W. L., Esq. (Jukes, J. B., Esq., & Du Noyer, G.V., Esq.), on the Mining district of Kenmare, 611-12.

Willson, W. L., Esq., (Jukes, J. B., Esq., & Du Noyer, G. V., Esq.), on the slates & limestones of Kenmare, 611,-14.
——————, " on the fossils they contain, 613.
——————, " on the metalliferous deposits of Kenmare, 614-15,-16,-18,-21.
Wilsworthy, on the native silver, arsenical cobalt, and copper-pyrites of, 116.
Winch, N. J., Esq., proportions of silver in the lead-ores of the North of England, 107.
Winding-engines, on the economy of substituting steam for horse-power, in, 142. 668.
Winzes and *levels*, substitution of, for *Stopes* in the mines of Cornwall, 146, 645-6,-93-4.
Wire-rope, advantages of, compared with hempen rope, 143, 646.
Wood, Benj., Esq., on the produce and profits of *Crennis*, 456; Table XIV.
Wooden pumps, generally used in the gold-mines of Brazil, 288.
Woods, their influence on the water of neighbouring springs, 137-140, 344.
——, laws for the protection of, in Brazil, 344.
Woodville, on the talcose-slate and auriferous deposits of, 375.
Woodward, Dr., on the argentiferous lead-ores of Cornwall, 118,-19.
Workmen in mines, extraordinary escapes of, 600,-66.

CHILI

E COLO

he Inch.



F. Hoskins del.

W. West Lith.

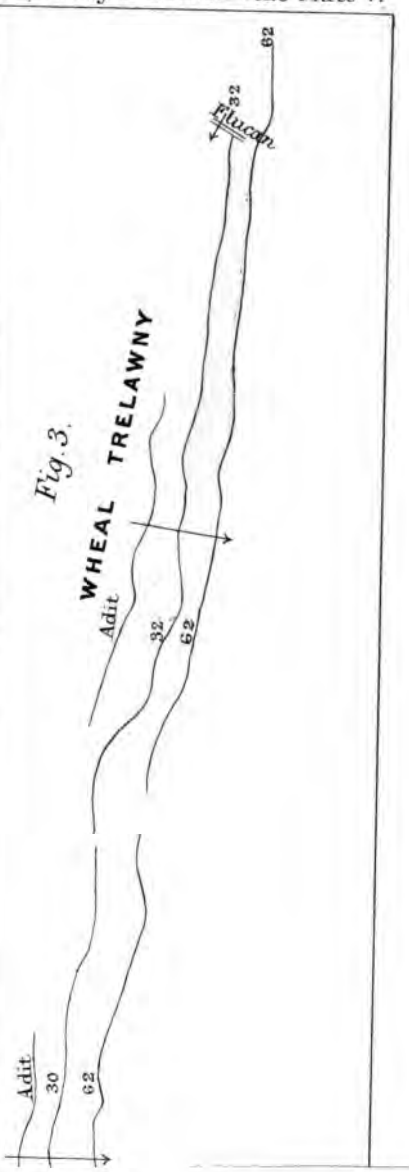


Fig. 3.
WHEAL TRELAWNY
Adit
32
62
Adit
30
62
32
Flucan
62

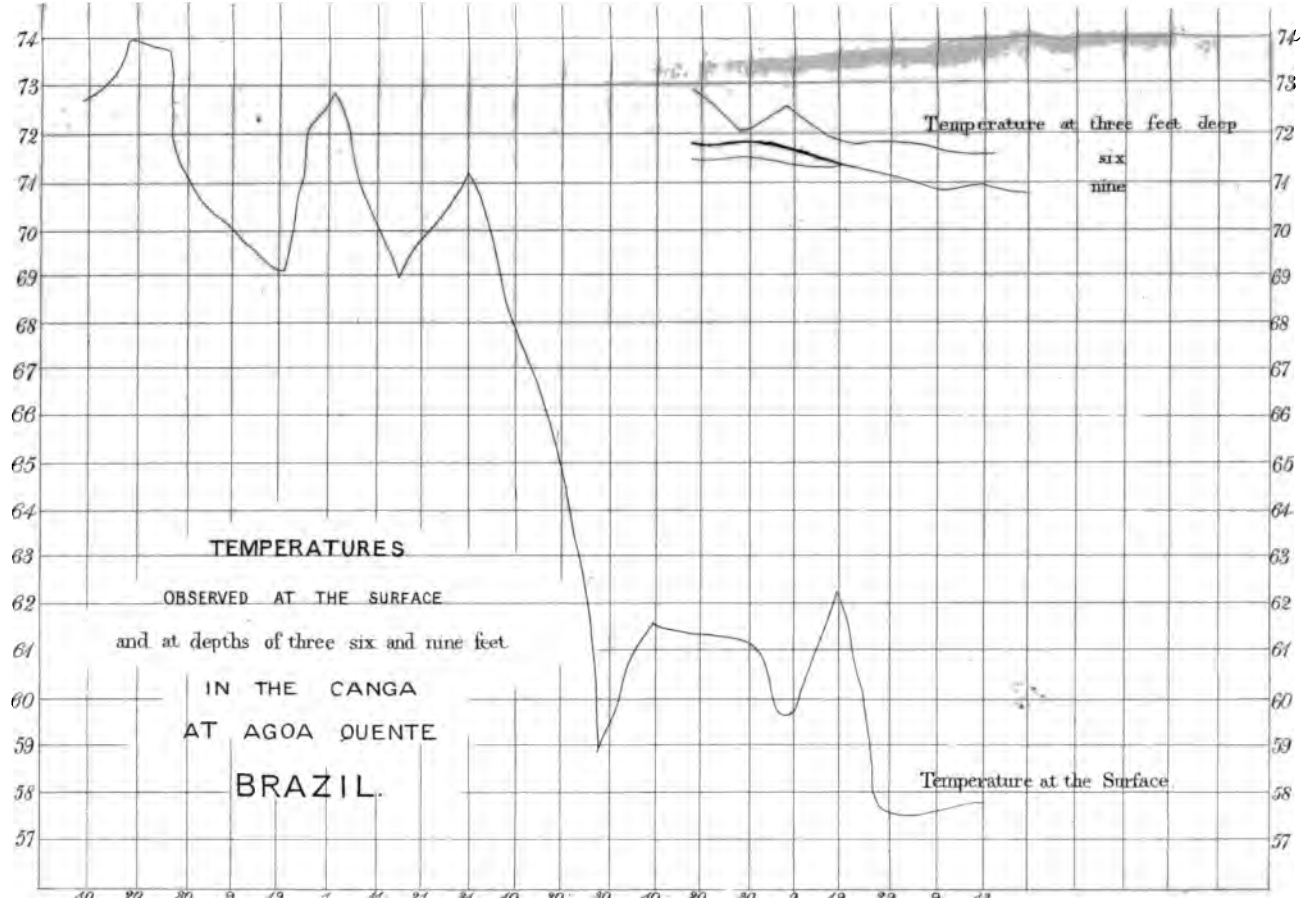

TEMPERATURES
OBSERVED AT THE SURFACE
and at depths of three six and nine feet
IN THE CANGA
AT AGOA QUENTE
BRAZIL.
Temperature at three feet deep
six
nine
Temperature at the Surface
74
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
58
57

Table I.

RELATIONS BETWEEN THE METALLIFEROUS DEPOSIT OF AGUR AND THE ROCKS WHICH ADJOIN IT.

Mine.	Bed.			Depth fms.	Composition and appearance of metalliferous bed.	Nature and appearance of adjoining rock.
	Direction.	Dip.	Size.			
Guarcoolee	S.E. & N.W.	N.E.	—	1	Specular (micaceous), brown, and magnetic iron-ore, with small lumps of the oxide of manganese. Structure lamellar.	Talc-slate with a little quartz.
Lhusganee	N. & S.	E. 22°-26°	6-8 feet.	20	Specular (micaceous) iron-ore, with a little quartz and some talc.	Quartzose talc-slate, dark blue, bedding N. & S., dip E.
Nutoa Kanh ..	E. & W.	N.	7-9 ,,	20	Idem. In four distinct beds, interlying the slate, but ultimately re-uniting.	Idem, sometimes blue sometimes drab; bedding E. & W., dip N.
Gallà	S.E. & N.W.	N.E.	7 ,,	10	Idem.	Beds of homogeneous blue slate, alternating with quartzose talc-slate.
Dhoora Khani ..	S.E. & N.W.	N.E.	2-7 ,,	17	Idem, with occasional masses of brown iron-ore.	Idem.
Capuà	N. & S.	E. 48°	1-3 ,,	Surface	Yellowish-brown iron-ore.	
			—	6	Brown and micaceous specular iron-ore, with a little quartz.	Homogeneous, fissile, pale blue, buff, and reddish-brown slate.
Choocootà	10° W. of N. & E. of S.	E. 40°	—	Surface	Brown iron-ore, mixed with the carbonate of iron and a little quartz.	Decomposed brownish talc-slate.
Bunnà	—	—	—	,,	Brown iron-ore and a little quartz.	Homogeneous, fissile, pale blue, passing into buff-coloured slate.
Purturburà	E. & W.	N. 24°	10-12 ,,	6·5	Some portions of the iron-ore pale others dark brown; masses of slate, in some places slightly impregnated in others veined with quartz.	Pale brown and buff talc-slate adjoining the ore; homogeneous dark blue slate at a little distance.

RELATIONS BETWEEN THE METALLIFEROUS DEPOSIT OF [illegible] AND KHETSAREE AND THE ROCKS WHICH ADJOIN IT.

Mine.	Bed.			Depth fms.	Composition and appearance of metalliferous bed.	Nature and appearance of adjoining rock.
	Direction.	Dip.	Size.			
Tilporà*	N. & S.	E. 20°–25°	2–5 feet.	5	Compact red iron-ore, with occasional stones of quartz; drusy cavities lined with earthy yellow iron-ore	Clay-slate; reddish-brown, with flakes of mica between the laminæ; joints curved, [illegible]

Table III

		9·2 fms.	
		7·7 fms.	
		6·5 fms.	
			e *branch.*

BUNCHES IN THE *COLORADA LODE.*

		Third Limestone.	
	pproximate uantity of Silver. bs. Troy.	Nature of ore.	Approximate quantity of Silver. lbs. Troy.
	—		
	106,600*		
	.....	Iron pyrites, blende, native silver, and sulphuret of silver.	—
	—*		
	53,300†		
	—†		
	40,000		
	23,300		
	166,600		
	—		
	.....	Arsenical silver ore, sulphuret of silver, red silver ore, and native silver.	—
	.....	Arsenical silver ore, red silver ore, and native silver.	—

Table IV.

Table XXXI.

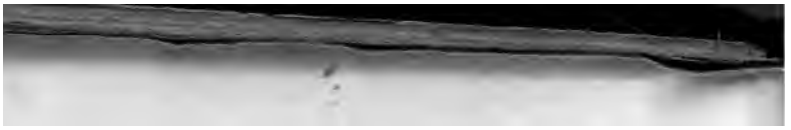
TEMPERATURE AT *AGOA QUENTE*,—BRAZIL.

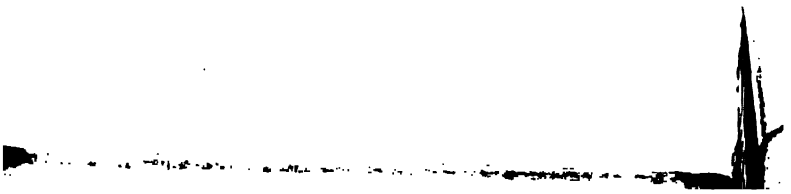
(Long. 43° 10′ W. Lat. 18° 50′ S. about 3,400 feet above the sea). Deduced from 2,398 observations in 1848 and 1849.

Months.	3 A.M.[b]			6 A.M.			9 A.M.			Noon.			4 P.M.			6 P.M.			8 P.M.[a]			9 P.M.			Midnight.[b]			Monthly Extremes & Means.		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
1848.																														
Oct. ..	65°	53°·5	60°·6	67°·3	56°·5	63°·2	74°·5	58°·5	67°·8	77°·5	68°	72°·7	79°·5	68°·5	73°·7	75°	63°	70°	73°·8	62°	68°·2	73°	61°	67°·5	69°	61°	65°·2	79°·5	53°·5	67°·5
Nov. ..	69°	52°	63·1	70·2	59°	65·7	74·5	63·6	69°	79°	68·2	73·5	82°	67·8	74·4	77·5	66·6	71·3	75°	64·3	69·1	74°	63·2	68·4	71°	54°	64·8	82°	52°	68·8
Dec. ..	71°	60°	66·1	72·3	63·8	69·6	78°	69·2	73·8	83°	73°	77·7	84°	73·5	77·8	79·5	71·2	75·2	76·3	69·2	72·9	74·2	63·2	72·2	73°	60°	68·2	84°	60°	72·6
1849.																														
Jan. ..	72°	61°	66·8	73°	67·4	70·1	78·5	69·3	74·2	84·5	70°	78·1	84·8	72°	79·1	81°	70·8	75·9	76·8	70°	73·4	76°	69°	72·6	73°	64°	68·5	84·8	61°	73·2
Feb. ..	70°	60°	65·2	72·8	62·8	68°	78·2	64·6	72·1	81·5	63·8	75·6	80·5	64·5	74·7	78°	63·5	72·6	75°	63·6	70·9	74·8	63·5	70·3	72°	60°	67.	81·5	60°	70·7
Mar. ..	68°	57°	65·4	70·2	61°	67·3	75·2	66·2	71·8	80·1	67·5	75·3	80·5	67°	75·2	78·2	64°	72°	74°	64·8	70·6	73°	65·2	69·8	70°	58°	66·5	80·5	57°	70·4
Apr. ..	69°	54°	62·6	70°	57·2	64·9	75°	62·5	69°	79°	67°	73·4	80°	65·5	73·5	75°	62°	70·4	72·2	60°	68·5	72°	59°	67·7	70°	57°	64·3	80°	54°	68·2
May ..	64°	42°	52·8	65·2	48·2	56·9	66·6	54°	61.4	71·5	62°	67·1	72·7	61·5	67·4	69°	58°	63·9	67°	56°	62·3	66°	55°	61·5	64°	50°	56·5	72·7	42°	61°
June ..	60°	43°	53·4	65°	47·5	56·9	66°	52·2	60·5	70°	62·3	66·3	73·4	64°	67·4	70°	58°	63·3	69·2	55°	61·9	69°	53·5	61·3	66°	48°	56·8	73·4	43°	60·7
July ..	54°	45°	47·6	56°	48·5	52°	60·5	54·2	56·8	66·4	63·2	64·7	68°	63·8	66·5	65°	60°	61°	63°	57°	63°	62·2	56·4	59·4	56°	48°	51·8	68°	45°	57·5
Extremes .	72°	42°	..	73°	48·2	..	78·5	52·2	..	84·5	62°	..	84·8	61·5	..	81°	58°	..	76·8	55°	..	76°	53·5	..	73°	48°	..	84·8	42°	..
Means ..	..	..	60·3	..	..	63·5	..	..	67·6	..	..	72·4	..	..	73°	..	..	69.5	..	..	67·8	..	..	67.	..	..	62·9	..	..	67°

a. The observations at 8 p.m. are not used in deducing the *Means*.

b. At Midnight, and at 3 a.m., Captains Pengilly, Luke, and Guy were the observers.





the Imperial Brazilia

M

OF THE SA

rom	Stamped xll.					
r hides baize; ashed amal- ation.	which esc ing the hi and baize collecte ground arrastres, re-washed amalgam	ort. Paid in cash.	Proceeds of gold dust sold.	Cost.	Loss.	Profit.

xn

the Imperial Brazilie

en

Table XI.

LODE 38° N. of W.	15.	N.E. 60°—72°	0·6—1·3	Calcareous spar, cellular quartz, (p. 421, Fig. 26,) enclosing small masses of hornblendic and felspathic rocks, thinly spotted with grains of native-copper.	Hornblende, labradorite, and chlorite. Coarse-grained;—an ill-defined bedding dips N.W. 40°—50°.
	26.	,, 66°-78°	0·1—2·5	*Idem*, with grains and small masses of native-copper. *The* MIDDLE VEIN *unites with the lode at this place.*	Idem;—traces of amygdaloidal structure.
	30.	,, 66°-82°	0·6—2·	Calcareous spar, quartz, and chlorite,—with traces of epidote and grains of native-copper. A vein of native-copper about a foot thick, slightly spotted with native-silver at intervals, adjoins the rock on the S.W. (lower side).	Hornblende, labradorite, and chlorite; of amygdaloidal structure. Idem;—the cavities filled with calcareous spar.
	46.	,, 60°-80°	0·1—6·	Calcareous-spar, chlorite, quartz, and epidote; enclosing small masses, and sprinkled with granules of native-copper. *At this place the* NORTH-EASTERN VEIN *unites with the lode.*	Idem.
	66.	,, 58°-74°	0 3—2·5	Calcareous-spar, chlorite, quartz, and epidote; thinly sprinkled with grains of native-copper, and enclosing masses of hornblendic and felspathic rocks.	Hornblende, labradorite, and chlorite.
	—	—	—	Neither *lode* nor *branch* has been traced in the crystalline greenstone.	Hornblende, labradorite, and chlorite; fine grained and crystalline. (*Ante*, p. 398.)
MIDDLE VEIN. S.E. & N.W.	26.	N.E. 72°—84°	0·8—1·	Calcareous spar, quartz, chlorite, and prehnite; thinly sprinkled with native-copper.	
NORTH-EASTERN VEIN. S.E. & N.W.	46.	N.E. 75°—85°	0·5	Calcareous-spar, quartz, prehnite, and chlorite; thinly sprinkled with native-copper.	

* Jackson, *Report on the Geological and Mineralogical Survey of Lands in Michigan*, III. pp. 458. Foster & Hill, *Ibid*, pp. 760—61. Foster & Whitney, *Report on the Geology of the Lake Superior Land District*, I. pp. 132,—46—7, *Pl. IX. Fig.* 20, Whitney, *Metallic Wealth of the United States*, p. 279. Rivot, *Annales des Mines*, 5me Série, VII. p. 315. *Mining Magazine* (New York, May, 1854), II. p. 557.

				although the nature of their earthy matrices may differ. Grains and small masses of silver encrust the copper at intervals. One portion of the vein-stone was so richly impregnated that a mass some 70 feet long, 20 deep, and from 3 to 6 thick was dislodged by a single blast.	
	130.	E. 75°-86°	1·0—3·0	The ingredients—as well earthy as metallic—are much the same as at 30 and 83 fms. deep. The largest masses of native-copper generally occur on or near the lower side *(foot wall)* of the *lode*. In *greenstone* the *lode* is always small and poor.*	Idem.

* Jackson, *Report on the Geological and Mineralogical Survey of Lands in Michigan*, III. pp. 459—60.
Foster & Whitney, *Report on the Geology of the Lake Superior Land District*, I. pp. 127—31,—72.
Whitney, *Metallic Wealth of the United States*, pp. 276—9.
Rivot, *Annales des Mines*, 5me Série, VII. pp. 510—14.
Lake Superior Miner (25th April, 1857), II. p. 2.
Daniel, *Mining Journal* (2nd September, 1865), XXXV. p. 567.

†*Ante*, p. 439.

THE DOUGLASS HOUGHTON OR *HENWOOD MINES.**—DISTRICT OF ONTONAGON. *Fig.* 28, 29.

Name & direction of vein.	Depth. fms.	Dip.	Size. feet.	Composition and appearance of Lode.	Composition and Structure of Rock.	*Lode.*
LODE [illegible]	Surface	N.W. 50°— [illegible]	A mere [illegible]	N.E. Quartz, calcareous-spar, epidote, and chlorite, [illegible] for the most part slightly charged with copper, but yielding here and there masses of 0·5–0·7 ton weight.	Hornblende mixed with smaller quantities [illegible]	N.E. of *Cross-vein*, a thin seam of epidote and chlorite spotted with copper. S.W. " unconnected masses of calcareous spar, quartz, epidote, & chlorite destitute of copper.
	71·		0·1—0·2	S.W. Short, narrow, and crooked veins of Laumonite, calcareous-spar, and chlorite, containing now and then a few particles of copper. *The productive portion has an endlong dip* (Shoot) *towards the south-west.*	Idem; fine-grained and crystalline.	
CONGLOMERATE LODE. 40°–50° E. of N.—W. of S.	Surface to 9.	N.W. 40°—45°	1·5	Nodules of trap and of quartz, cemented by calcareous-spar, epidote, and disintegrated trap. Particles of copper are thinly sprinkled through the matrix.	Idem.	
	71.	" 38°–42°	0·5—0·8	A *(leader)* central vein of calcareous-spar, quartz, Laumonite, and trap, thinly spotted with particles of copper; bounded on either side by disintegrated trap.	Idem.	
CROSS-VEIN S.E. & N.W.	48.	N.E. 80°—P.	0·5	Disintegrated ferruginous trap.	Idem.	

* Jackson, *Report on the Geological and Mineralogical Survey of Lands in Michigan*, III. pp. 455, 702.
Foster & Whitney, *Report on the Geology of the Lake Superior Land District*, I. pp. 142—50. Whitney, *Metallic Wealth of the United States*, pp. 289—90.
Lake Superior Miner, XI. (24th March, 1856), p. 224. Henwood, *Report on the Douglas Houghton Mine* (Detroit, 1859), pp. 1—9.
Ingram, Coulter, Douglass, and Rudolph, *Exhibit of the Henwood Mine* (New York, 1864), pp. 10—18.
† Henwood, *Cornwall Geol. Trans.*, V. pp. 25, 328; *Table LXXXIV.* ‡ *Ibid*, pp. 172,—81,—2; *Tables XVIII.*, *XCV.*

		N.W. 76°—84°	3·0—3·5	S.W. The *lode* affects two distinct, though subordinate, veins. On the N.W. (upper) side, it consists for 2·5 feet in width of felspathic-clay, granular quartz, chlorite, and calcareous spar, in which masses of agatine quartz (*a*) are occasionally imbedded. On the S.E. (lower) side similar ingredients, mixed with granular iron-pyrites, argentiferous galena, earthy black silver-ore, and—much less frequently—with grains of red silver.	Idem.	
	64·	N.W. 66°—74°	2·0—6·0	N.E. Felspathic and hornblendic rock mixed and veined with calcareous-spar, thinly spotted with earthy brown iron-ore, and still more thinly with earthy black silver-ore.	Felspar and hornblende, mixed and veined with calcareous-spar. Structure generally massive.	
		N.W. 70°—76°	5·0	— The same earthy ingredients, enclosing small rich *bunches* and narrow veins of earthy black silver-ore.	Pale yellow felspar, chlorite, and hornblende, slighty mixed with calcareous-spar. Many joints are faced with steatitic matter.	
		N.W. 72°	1·5	S.W. Pale-yellow felspar, chlorite, and calcareous-spar; slightly mixed with argentiferous galena, earthy black silver-ore and minute crystals of red silver.	Idem.	
COPPER LODE. N.E.—S.W.	14·	N.W. 70°	4·0—5·0	N.W. or upper side, yellowish felspathic clay, enclosing masses of calcareous-spar spotted with iron-pyrites. S.E. or lower side, earthy reddish-brown iron-ore and granular quartz, enclosing nests filled with felspar-clay, earthy manganese, or calcareous-spar.	Felspar & hornblende, traversed by thin veins of calcareous spar; in ill-defined beds, of massive structure, which dip towards the N.E.	
		N.W. 72°	—	Idem.		
		N.W. 75°	—	N.W. Earthy reddish-brown iron-ore, containing isolated masses of felspar-clay, of calcareous-spar, and of iron-pyrites.	Idem. Idem.	
	44·	—	—	The *lode* affects two distinct veins.		
		N.W. 70°	2·5	N.W. vein,—felspar-clay, earthy brown iron-ore, granular quartz, and—at intervals—spots of calcareous-spar. A narrow vein of copper-pyrites traverses the iron-ore. S.E. „ „,—felspar-clay, sprinkled with granular quartz, veined with calcareous-spar, and spotted with iron-pyrites.		

* The mine is about ninety fathoms deep, and some of its (galleries) *levels* are extended nearly sixty fathoms beneath the sea.

Name & direction of Metalliferous deposit.	Depth. fms.	Dip.	Size. feet.	Composition and appearance of Metalliferous deposit.	Composition and structure of Rock.
SULPHUR.	7.	S.E. 48°	8.	Earthy brown iron-pyrites [illegible] ore.	[illegible]
	,,	S.E. 45°—50°	5·—6·	S.W. ,, N.W. side. } Dark-blue argillaceous matter and iron-pyrites; of thick lamellar structure. ,, S.E. side. } Slaty clay enclosing isolated masses of iron-pyrites, small bodies of copper-pyrites, and scattered lumps of vitreous copper encrusted with earthy black copper.	
	84·	.....	.....	..... Slaty-clay unequally sprinkled with granular iron-pyrites, and — less frequently — with yellow copper-ore.‖	
SOUTH BRANCH. 30°—45° E. of N.—W. of S.	54· to 58·	S.E. 20°—30°	3·—4·	Layers of slaty-clay alternating with broader beds of granular quartz and of friable iron-pyrites mixed with argillaceous matter. Some portions of the quartz are spotted and veined with earthy black copper-ore, vitreous copper, and copper-pyrites; other parts are slightly flecked with native copper at intervals.	Clay-slate; S.E. side *(wall)*. The planes of cleavage dip 40° S.E.
WALL'S LODE. 30°—45° E. of N.—W. of S.	10·	S.E. 50°	3·—4·	Thin beds, alternately of fissile greyish-blue slate, and of granular quartz mixed with slaty-clay, earthy brown iron-ore, and friable iron-pyrites, sprinkled and sparingly veined with earthy black copper-ore at intervals.‖ The pyrites is, in general, slightly auriferous; one sample yielded (0·000015 its weight) half an ounce of gold per ton of ore.‖	Clay-slate; greyish-blue mottled with white, fissile. The planes of cleavage dip 50° S.E.

* MSS. of the late Nicholas Kempston, Esq., of *The Meeting of the Waters*, Superintendent of *Connorree*.

† Henwood, *Proceedings of the Royal Geol. Soc. of Cornwall (West Briton*, 9th Oct., 1840). Smyth, *Records of the School of Mines*, I. p. 392.

‡ Weaver, *Geol. Trans.* v. p. 215. MSS. of the late Percival Norton Johnson, Esq., F.R.S., F.G.S., &c. Smyth, *Records of the School of Mines*, I. p. 394. Mahon, *The Mines of Wicklow*, p. 58.

§ Smyth, *Records of the School of Mines*, I. p. 313, *Fig.* 17.

‖ Markham Browne, Esq., Resident Director, & W. G. Roberts, Esq., Manager, of *Connorree*. Mahon, *The Mines of Wicklow*, p. 63.

	—	—	—	—	
18	1·2288	0·0211	0·0239	0·0718	0·0582
79	0·8478	0·0283	0·0277	0·0549	0·0647
91	0·6528	0·0441	0·0352	0·0769	0·1178
	—	—	—	—	0·0798
87	0·9995	—	0·0284	0·0731	0·0731
67	0·8979	—	0·0287	0·0902	0·1004
33	0·6505	—	0·0230	0·0670	0·1029
81	0·7284	—	0·0265	0·0776	0·1066
75	1·0239	0·0184	0·0308	0·0993	0·0969

prises broken machinery and large junks of any kind."
ent of the *Mona* Mine and Smelting Works.

Table XX.

THE *MOUNTAIN LODES* OF THE *(ALLIHIES) BEARHAVEN* MINES—COUNTY OF CORK.

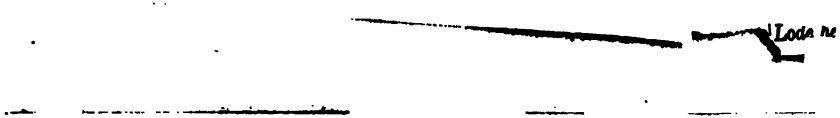
Name & direction of vein.	Depth. fms.	Dip.	Size. feet.	Composition and appearance of vein.	Composition and structure of Rock.	Main Lode.	Cross-course.
				and quartzose slate, slightly—but unequally—mixed with calcareous-spar, and thinly sprinkled with copper-pyrites.		At less than 20 fms. from the surface the *lodes* unite; but at greater depths they are separated some 18 feet by siliceous slate, which—as well resembling the adjoining rocks in composition as containing with them in direction and dip—form the continuous N. *wall* of the *Main lode.* d *	
	140·	.....	.....	As the *Mountain lode* improves, the *Main lode* declines, in quality.g	..... (c)		
	202·	68°—76°	46·—60·	Quartz largely mixed with copper-pyrites.	Buff-coloured, thick lamellar slate; of which the cleavage dips N. 78°—85°.		
	214·	70°—78°	50·—62·	Idem.	Idem.		
	226·	70°—76°	48·—60·	Quartz largely charged with copper-pyrites for about 20 fathoms in length.			
	240·	64°—72°	40·—54·	Quartz and quartzose slate, mixed with copper-pyrites, and with the carbonate of iron and calcareous-spar in smaller proportions. The mass of copper-ore dips or *shoots* towards the N.			
CROSS-COURSE N.E.—S.W.	93·	S.E. 80°	3·—4·	The *Cross-course* consists mostly of quartz, where it intersects the *Main lode;* but mostly of slaty-clay elsewhere.e	Buff or lilac-coloured slate.	(e)	
	115·	76°—84°	4·—5·	Idem.	..... Idem.	(f)	

* Captain Henry Pascoe, A.R.G.S C., Manager of the Mines, MSS.

THE *MOUNTAIN LODES* OF THE *(ALLIHIES) BEARHAVEN* MINES—COUNTY OF CORK.

Name & direction of vein.	Depth. fms.	Dip.	Size. feet.	Composition and appearance of vein.	Composition and structure of Rock.	Main Lode.	Cross-course.
				and quartzose slate, slightly—but unequally—mixed with calcareous-spar, and thinly sprinkled with copper-pyrites.		At less than 20 fms. from the surface the *lodes* unite; but at greater depths they are separated some 18 feet by siliceous slate, which—as well resembling the adjoining rocks in composition as co-inciding with them in direction and dip—form the continuous N. *wall* of the *Main lode.* d *	
	140·	.....	.....	As the *Mountain lode* improves, the *Main lode* declines, in quality.g	..... (c)		
	202·	68°—76°	46·—60·	Quartz largely mixed with copper-pyrites.	Buff-coloured, thick lamellar slate; of which the cleavage dips N. 78°—85°.		
	214·	70°—78°	50·—62·	Idem.	Idem.		
	226·	70°—76°	48·—60·	Quartz largely charged with copper-pyrites for about 20 fathoms in length.			
	240·	64°—72°	40·—54·	Quartz and quartzose slate, mixed with copper-pyrites, and with the carbonate of iron and calcareous-spar in smaller proportions. The mass of copper-ore dips or *shoots* towards the N.			
CROSS-COURSE N.E.—S.W.	93·	S.E. 80°	3·—4·	The *Cross-course* consists mostly of quartz, where it intersects the *Main lode;* but mostly of slaty-clay elsewhere.e	Buff or lilac-coloured slate.	(e)	
	115·	76°—84°	4·—5·	Idem.	..... Idem.	(f)	

* Captain Henry Pascoe, A.R.G.S C., Manager of the Mines, MSS.


Loda re

,—AND COST OF

		Gold obtained.	
rains per ton.)	Total rage.	During the period.	Total.

e,
ed
ly
æ
k-
ip

ss
th
ns

MARKE VALLEY MINE, PARISH OF LINKINHORNE.

Name and Direction of Vein.	Depth. fms.	Dip.	Size. feet.	Composition and appearance of Vein.	Composition and structure of Rock.	Cross-course.
OLD SARUM LODE, 15°—20° N. of E.—S. of W.	91	N. 50°	1—4	W. Quartz, chlorite, and felspar, thickly sprinkled and veined with iron-pyrites, mixed sometimes with copper-pyrites, and less frequently with tin-ore.	Slate of thick lamellar structure, silky lustre, and purple hue. The planes of cleavage dip E.N.E. 40°; and three series of joints bear respectively 40°—45° N. of E.—S. of W; 20°—25° S. of E.—N. of W; and 20°—25° E. of S.—W. of N.	
	"	N. 50°-55°	14—22	E. Quartz, occasionally seamed with chlorite, mostly crystalline, and slightly cellular; the small cavities being frequently lined with minute crystals of quartz, and stud-	*Elvan;* basis of yellowish-white felspar and quartz, sprinkled with small crystals of schorl; enclosing—towards the middle—large crystals of pink and milk-white fel-	

MARKE VALLEY MINE, PARISH OF LINKINHORNE.

Name and Direction of Vein.	Depth. fms.	Dip.	Size. feet.	Composition and appearance of Vein.	Composition and structure of Rock.	Cross-course.
OLD SARUM LODE, 15°—20° N. of E.—S. of W.	91	N. 50°	1—4	W. Quartz, chlorite, and felspar, thickly sprinkled and veined with iron-pyrites, mixed sometimes with copper-pyrites, and less frequently with tin-ore.	Slate of thick lamellar structure, silky lustre, and purple hue. The planes of cleavage dip E.N.E. 40°; and three series of joints bear respectively 40°—45° N. of E.—S. of W; 20°—25° S. of E.—N. of W; and 20°—25° E. of S.—W. of N.	
	"	N. 50°-55°	14—22	E. Quartz, occasionally seamed with chlorite, mostly crystalline, and slightly cellular; the small cavities being frequently lined with minute crystals of quartz, and stud-	*Elvan;* basis of yellowish-white felspar and quartz, sprinkled with small crystals of schorl; enclosing—towards the middle—large crystals of pink and milk-white fel-	

	ıd hornblendic matter, of crystalline character, but dis-	
	ıd hornblendic rocks, fine-grained, massive, and traversed ints; passing gradually into homogeneous slate.	
	(*a*)	
	(*b*)	

rans., VII. (1852), p. 204.

NOCK.

Name and Direction of Vein.	Depth Fms.	Dip.	re of Rock.	Flucan.
LODE. 3°—12° W. of N.—E. of S.	4	E. 80°	stre; of thick lamellar struc- s: the planes of cleavage dip r, respectively parallel to the 1 40°-45° E. of N.—W. of S.	
	18	E. 80°	1·	
	86	E. 74°-80°	0·6 beds of quartz. (*a*)	*Lode heaved* 6 feet R.G.A.
	"	"		
	"	"	in the E. portion of the *lode*, occur towards the S., the rock, k lamellar slate, of which the	
	98	E. 80°—P.	1·ip S. 8°—10°: joints, parallel crystals of pearl-spar.	
	110	E. 70°-80°	Sev ve	
	121	E. 85°—W. 80°	dip N. 10°—15°; many joints	
	131	E. 80°—P.	1 dip S. 6°—8°; traversed by artz parallel to the *lodes*.	
	141	E. 82°	2 e nearly horizontal; the joints *lode*.	
	"	"	1 ip S. 10°—12°.	
FLUCAN. 20°—25° E. of N.—W. of S.	86	N.W. 50°-60°	3	

* Giles, *Transac*

† Salmon, *Minin Liskeard District*, p. 17.

Table XXXI.

TEMPERATURE AT *AGOA QUENTE*,—BRAZIL.

(Long. 43° 10′ W. Lat. 18° 50′ S. about 3,400 feet above the sea). Deduced from 2,398 observations in 1848 and 1849.

Months.	3 A.M.[b]			6 A.M.			9 A.M.			Noon.			4 P.M.			6 P.M.			8 P.M.[a]			9 P.M.			Midnight.[b]			Monthly Extremes & Means.		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
1848.																														
Oct. ..	65°	53·5°	60·6°	67·3°	56·5°	63·2°	74·5°	58·5°	67·8°	77·5°	68°	72·7°	79·5°	68·5°	73·7°	75°	63°	70°	73·8°	62°	68·2°	73°	61°	67·5°	69°	61°	65·2°	79·5°	53·5°	67·5°
Nov. ..	69°	52°	63·1	70·2	59°	65·7	74·5	63·6	69°	79°	68·2	73·5	82°	67·8	74·4	77·5	66·6	71·3	75°	64·3	69·1	74°	63·2	68·4	71°	54°	64·8	82°	52°	68·8
Dec. ..	71°	60°	66·1	72·3	63·8	69·6	78°	69·2	73·8	83°	73°	77·7	84°	73·5	77·8	79·5	71·2	75·2	76·3	69·2	72·9	74·2	63·2	72·2	73°	60°	68·2	84°	60°	72·6
1849.																														
Jan. ..	72°	61°	66·8	73°	67·4	70·1	78·5	69·3	74·2	84·5	70°	78·1	84·8	72°	79·1	81°	70·8	75·9	76·8	70°	73·4	76°	69°	72·6	73°	64°	68·5	84·8	61°	73·2
Feb. ..	70°	60°	65·2	72·8	62·8	68°	78·2	64·6	72·1	81·5	63·8	75·6	80·5	64·5	74·7	78°	63·5	72·6	75°	63·6	70·9	74·8	63·5	70·3	72°	60°	67.	81·5	60°	70·7
Mar. ..	68°	57°	65·4	70·2	61°	67·3	75·2	66·2	71·8	80·1	67·5	75·3	80·5	67°	75·2	78·2	64°	72°	74°	64·8	70·6	73°	65·2	69·8	70°	58°	66·5	80·5	57°	70·4
Apr. ..	69°	54°	62·6	70°	57·2	64·9	75°	62·5	69°	79°	67°	73·4	80°	65·5	73·5	75°	62°	70·4	72·2	60°	68·5	72°	59°	67·7	70°	57°	64·3	80°	54°	68·2
May ..	64°	42°	52·8	65·2	48·2	56·9	66·6	54°	61.4	71·5	62°	67·1	72·7	61·5	67·4	69°	58°	63·9	67°	56°	62·3	66°	55°	61·5	64°	50°	56·5	72·7	42°	61°
June ..	60°	43°	53·4	65°	47·5	56·9	66°	52·2	60·5	70°	62·3	66·3	73·4	64°	67·4	70°	58°	63·3	69·2	55°	61·9	69°	53·5	61·3	66°	48°	56·8	73·4	43°	60·7
July ..	54°	45°	47·6	56°	48·5	52°	60·5	54·2	56·8	66·4	63·2	64·7	68°	63·8	66·5	65°	60°	61°	63°	57°	63°	62·2	56·4	59·4	56°	48°	51·8	68°	45°	57·5
Extremes .	72°	42°	..	73°	48·2	..	78·5	52·2	..	84·5	62°	..	84·8	61·5	..	81°	58°	..	76·8	55°	..	76°	53·5	..	73°	48°	..	84·8	42°	..
Means ..	..	..	60·3	..	..	63·5	..	..	67·6	..	..	72·4	..	..	73°	..	..	69.5	..	..	67·8	..	..	67.	..	..	62·9	..	..	67°

a. The observations at 8 p.m. are not used in deducing the *Means*.

b. At Midnight, and at 3 a.m., Captains Pengilly, Luke, and Guy were the observers.

Table XXXII.

FFERENT COUNTRIES.

Less than 200 fms. above the sea.																
In temperate regions.																
NDS. *a b*	IRELAND. *a b*				ENGLAND (Cornwall). *a b*				ENGLAND (Salop *b*).				MEANS.			
Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.
	6	20	51°·6		2	32	51°·4		1	15	54°·	..	41	28	61°·	
10·	3	60	51·3	14·1	4	78	62·2	4·3	..	..	..	..	17	65	60·5	21·4
..	3	127	59·2		7	116	65·8	10·6	..	..	..	..	14	122	65·4	
..	..	..	..	..	..	..	..	..	..	..	..	..	2	155	72·	5·
..	..	..	..	..	..	..	..	..	..	..	..	..	2	227	73·2	60·
..	12	..	..	..	13	..	..	..	1	..	..	..	76	..	..	..
10·	..	57	53·4	14·1	..	92	62·5	5·8	..	15	54·	..	..	62	62·3	16·3

I.

FFERENT COUNTRIES.

Less than 200 fms. above the sea.																
In temperate regions.																
NDS. *a b*	IRELAND. *a b*				ENGLAND (Cornwall). *a b*				ENGLAND (Salop *b*).				MEANS.			
Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.
	6	20	51°·6		2	32	51°·4		1	15	54°·	..	41	28	61°	
10·	3	60	51·3	14·1	4	78	62·2	4·3	..	..	..	..	17	65	60·5	21·4
								10·6								
..	3	127	59·2		7	116	65·8		..	..	..	..	14	122	65·4	
																5·
..	..	..	..	..	..	..	..	..	..	..	..	..	2	155	72·	
																60·
..	..	..	..	..	..	..	..	..	..	..	..	..	2	227	73·2	
..	12	..	..	..	13	..	..	..	1	..	..	..	76	..	..	..
10·	..	57	53·4	14·1	..	92	62·5	5·8	..	15	54·	..	..	62	62·3	16·3

the thermal springs at *Agoa Quente* (*c*) have not been reckoned in these averages.

r Rocks.

ACOTINGA, *c*			TALCOSE, MICACEOUS, & CHLORITIC SLATES, *b*				GRANITE, *a b*				MEANS.			
Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.
37	67°·3	0·	2	18	62°·9		2	32	51°·4		41	28	61°	
62	67·3		..	..	..		..	..	..	5·8	17	65	60·5	21·4
..	..		..	..	..		2	126	67·6		14	122	65·4	
..	..		..	..	..		..	..	..		2	155	72·	5·
..	..		..	..	..		..	..	..		2	227	73·4	60·
..	..	..	2	..	..	..	4	..	..	..	76	..	..	..
40	67·3	0·	..	18	62·9	..	..	79	59·5	5·8	..	62	62·3	16·3

ıter pumped out of mines (*b*),—and of the thermal springs at *Agoa Quente* (*c*).

Table XXXIV.

Subterranean Temperature in Mines yielding different Metals and Ores.

Depths.	Gold. *bc*				Silver.				Lead. *ab*				Copper. *ab*				Copper & Tin. *a*				Means.			
	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.
Surface to 50 fms.	23	31	66°·6		1	46	64°·8	..	2	34	55°·8	..	15	22	52°·6	..	..	..	..	..	41	28	61°·	
50 ,, 100 ,, ...	5	64	67·6	33·	..	..	..	38·3	7	70	60·2	8·2	5	58	53·7	32·7	..	..	..	..	17	65	60·5	21·4
100 ,, 150 ,, ...	2	147	71·4	21·8	2	138	67·2	..	2	121	66·2	8·5	3	127	59·2	12·6	5	114	65°·7	..	14	122	65·4	
150 ,, 200 ,, ...	2	155	72·	13·3	..	..	..	14·8	..	..	..	..	..	..	..	..	..	..	..	..	2	155	72·	5·
200 ,, and beyond ..	..	..	..	..	2	227	73·2	..	..	..	..	..	..	..	..	..	..	..	..	..	2	227	73·2	60·
Totals	32	..	..	..	5	..	..	..	11	..	..	..	23	..	..	..	5	..	..	..	76	..	..	..
Means	..	51	67·5	23.	..	155	69·2	21·5	..	72	60·7	8·4	..	43	53·7	15·9	..	114	65·7	..	..	62	62·3	16·3

In deducing these results, the temperatures—of wells at the surface (*a*),—of the water pumped out of mines (*b*),—and of the thermal springs at *Agoa Quente* (*c*) have not been taken into account.

Table XXXVI.

Subterranean Temperature in Mines situate at different elevations above the Sea.

More than 200 fms. above the Sea. (In tropical regions.) *b c*					Less than 200 fms. above the Sea. (In temperate regions.) *a b c*					Means.				
Depths.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	Depths.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	Depths.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.
Surface to 50 fms.	24	32	66·7°		Surface to 50 fms	17	23	53·°		Surface to 50 fms.	41	28	61·°	
				35·5					9·3					
50 „ 100 „	5	64	67·6		50 „ 100 „	12	65	57·5		50 „ 100 „	17	65	60·5	21·4
				46·5					8·6					
100 „ 150 „	4	143	69·3		100 „ 150 „	10	119	63·8		100 „ 150 „	14	122	65·4	
				4·5										5·
150 „ 200 „	2	155	72·		150 „ 200 „	..	..	..	..	150 „ 200 „	2	155	72·	
				60·										60·
200 and beyond	2	227	73·2		200 and beyond	..	..	..	..	200 and beyond	2	227	73·2	
Totals	37	..	..	..	Totals	39	..	..	..	Totals	76			
Means	..	65	67·7	30·	Means	..	61	57·	8·9	Means	..	62	62·3	16·3

In deducing these averages, the temperatures—of wells at the surface (*a*),—of the water pumped out of mines (*b*),—and of the thermal springs at *Agoa Quente* (*c*), have not been taken into account.

Table XXXVI.

Subterranean Temperature in Mines situate at different elevations above the Sea.

More than 200 fms. above the Sea. (In tropical regions.) *b c*					Less than 200 fms. above the Sea. (In temperate regions.) *a b c*					Means.				
Depths.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.	Depths.	No of observations.	Mean depths. fms.	Temperatures.	Ratios.	Depths.	No. of observations.	Mean depths. fms.	Temperatures.	Ratios.
Surface to 50 fms.	24	32	66°·7	35·5	Surface to 50 fms	17	23	53°	9·3	Surface to 50 fms.	41	28	61°	21·4
50 „ 100 „	5	64	67·6	46·5	50 „ 100 „	12	65	57·5	8·6	50 „ 100 „	17	65	60·5	
100 „ 150 „	4	143	69·3	4·5	100 „ 150 „	10	119	63·8		100 „ 150 „	14	122	65·4	
150 „ 200 „	2	155	72·	60·	150 „ 200 „	..	..	..	..	150 „ 200 „	2	155	72·	5·
200 and beyond	2	227	73·2		200 and beyond	..	..	..	..	200 and beyond	2	227	73·2	60·
Totals	37	..	..	..	Totals	39	..	..	..	Totals	76			
Means	..	65	67·7	30·	Means	..	61	57·	8·9	Means	..	62	62·3	16·3

In deducing these averages, the temperatures—of wells at the surface (*a*),—of the water pumped out of mines (*b*),—and of the thermal springs at *Agoa Quente* (*c*), have not been taken into account.